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TO HOLDERS OF SYSTEM DESCRIPTION AND OPERATION MANUAL, PUB. NO. A15-1146-096, PRIMUS 1000 INTEGRATED AVIONICS SYSTEM

REVISION NO. 001 DATED 11 MAY 2007

This revision replaces some data in the manual. All changed pages have a new date, as identified in the List of Effective Pages. Revision bars identify the changed data.

Put the changed pages in the manual and remove and discard all replaced pages. Write the revision number, revision date, and replacement date on the Record of Revisions page.

Page	Description of Change
T-1 thru T-4	Changed to show the revision date. Replaced the Proprietary Notice with the new Honeywell Materials License Agreement.
LEP-1 thru LEP-8	Changed to show the changed pages in the manual.
TC-1 thru TC-20	Changed to show where information is located in the manual.
INTRO-3	Updated the Customer Support data.
2-1-3	Added IC-615 IAC Leading Particulars information to Table 2-1-1.
2-5-4	Added IC-615 IAC Leading Particulars information to Table 2-5-1.
2-6-4	Added IC-615 IAC Leading Particulars information to Table 2-6-1.
4-13, 4-14, 4-14.1, 4-14.2	Added procedure to replace the IC-615 battery. Added Figure 4-3, IC-615 Battery Cover Location. Relocated some data.

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System Description and Operation Manual

PRIMUS 1000 Integrated Avionics System

Cessna Citation XLS

Publication Number A15-1146-096, Revision 001

Revised 11 May 2007
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SYSTEM DESCRIPTION AND OPERATION MANUAL

Cessna Citation XLS

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INTRODUCTION

1. How to Use This Manual

A. General

(1) The purpose of this manual is to help the avionics specialist better understand the operation and troubleshooting of the PRIMUS 1000 Integrated Avionics System to the line replaceable unit (LRU) level, as installed on the Cessna Citation XLS aircraft.

(2) This manual provides overall system and subsystem general description, LRU leading particulars, and subsystem functional operation. This manual covers subsystem and overall system interface and interconnect information to aid the avionics specialist in a general understanding of the system.

(3) This manual is not designed or approved to conduct maintenance on the aircraft. The aircraft maintenance manual (AMM) should be used for all maintenance procedures, practices, and LRU part number references.

(4) Additional information on subsystems installed as part of the PRIMUS 1000 Integrated Avionics System is available in the publications shown in paragraph 3. of this Introduction.

(5) Warnings, cautions, and notes in this manual give the data that follows:

- A WARNING gives a condition or tells personnel what part of an operation or maintenance procedure, that if not obeyed, can cause injury or death.
- A CAUTION gives a condition or tells personnel what part of an operation or maintenance procedure, that if not obeyed, can cause damage to the equipment.
- A NOTE gives data, not commands. The NOTE aids personnel when they do the related instruction.

(6) Warnings and cautions go before the applicable paragraph or step. Notes follow the applicable paragraph or step.

B. How This Manual Is Organized

(1) The material in this manual has been arranged so that experienced maintenance and service personnel can refer directly to those sections that relate to their work, while the less experienced reader can find the manual a valuable introduction to the PRIMUS 1000 Integrated Avionics System. This manual is organized into the seven sections that follow:

(2) Section 1 - System Overview

(a) The purpose of this section is to give the reader a brief overview of how the entire PRIMUS 1000 Integrated Avionics System is organized, define terms used in the sections that follow, and to serve as a guide for further study of these sections. The numerous digital data buses used within the PRIMUS 1000 Integrated Avionics System are also discussed here.

(3) Section 2 - System Description

(a) This section is divided into nine subsections that give information about Honeywell manufactured subsystems for the PRIMUS 1000 Integrated Avionics System. Each subsection describes the function and interface of the LRU of each subsystem, as well as subsystem operation and cockpit displays. Block diagrams of subsystem interface, figures, and tables are included as an aid to understanding system operation. The nine subsections are as follows:

- Section 2-1 – Electronic Display System
- Section 2-2 – ADZ-950 Micro Air Data System
- Section 2-3 – PRIMUS 880 Weather Radar System
- Section 2-4 – PRIMUS II Integrated Radio System
- Section 2-5 – Flight Guidance System
- Section 2-6 – Autopilot/Yaw Damper System
- Section 2-7 – Enhanced Ground Proximity Warning System
- Section 2-8 – Traffic Alert and Collision Avoidance System
- Section 2-9 – AA-300 Radio Altimeter System

(4) Section 3 – System Interconnect

(a) This section refers to a Honeywell engineering document which contains wiring data for the PRIMUS 1000 Integrated Avionics System and to the approved aircraft maintenance documents. Use the approved aircraft maintenance documents to check the components of the PRIMUS 1000 Integrated Avionics System for correct installation and proper operation.

(5) Section 4 – Maintenance Practices

(a) This section describes the procedures to remove and reinstall the Honeywell LRUs. Procedures are also supplied to replace lamps, set screws, and knobs. Where applicable, adjustment data is also supplied. This section is divided into paragraphs that are in alphabetical order according to the unit type designator.

(6) Section 5 – Shipping/Handling and Storage

(a) This section refers the user to a Honeywell document for shipping, handling, and storage of all system components.

(7) Section 6 – Honeywell Support

(a) This section briefly describes Honeywell’s worldwide exchange/rental program (commonly referred to as SPEX) for spares. Telephone numbers and addresses of Honeywell’s support centers are also included.

(8) Section 7 – System Test and Fault Isolation

(a) This section refers the user to the approved aircraft maintenance documents for system test and fault isolation procedures. Use these documents to check the components of the PRIMUS 1000 Integrated Avionics System for correct installation and proper operation.

C. Weights and Measurements

(1) All component weights and measurements are in U.S. and S.I. (metric) values.

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- E-mail: cas-publications-distribution@honeywell.com
- Fax: 602-822-7272
- Phone: 800-601-3099 (U.S.A.)
- Phone: 602-365-3099 (International).

(2) Also, the Customer Response Center is available if you need to:

- Identify a change of address, telephone number, or e-mail address
- Make sure that you get the next revision of this manual.

3. References

A. Honeywell Publications

(1) Related Honeywell publications are identified in the list that follows:

- PRIMUS 1000 Control Display System Pilot's Manual, Pub. No. A28-1146-170
- PRIMUS 880 Weather Radar System Pilot's Manual, Pub. No. A28-1146-102
- PRIMUS 880/660/440 Weather Radar System Description and Installation Manual, Pub. No. A09-3944-001
- PRIMUS II Integrated Radio System Pilot's Manual, Pub. No. A28-1146-050
- PRIMUS II SRZ-85X Integrated Radio System Operation and Installation Manual, Pub. No. A15-3800-001
- PRIMUS II Integrated Radio System Event Codes Pocket Guide, Pub. No. A04-3800-01
- RCZ-851E Module Installation Instructions, Pub. No. 62-0097-000-02
- RNZ-850 Module Installation Instructions, Pub. No. 62-0096-000-02
- Electronic Programmable Checklist, Pub. No. A35-3642-002-01
- Handling, Storage, and Shipping Procedures for Honeywell Avionics Equipment Instruction Manual, Pub. No. A09-1100-001.

B. Other Publications

(1) These publications are standard references:

- The United States Government Printing Office (GPO) Style Manual 2000 (available at http://www.gpoaccess.gov/stylemanual/browse.html)
- ANSI/IEEE Standard (Std) 260 (1978), Standard Letter Symbols for Units of Measurement (available from the American National Standards Institute, New York, NY)
- ASME Y14.38-1999 (Formerly ASME Y1.1-1989), Abbreviations for Use on Drawings and in Text (available from the American National Standards Institute, New York, NY)
- ANSI Y32.2 (1975), Graphic Symbols for Electrical and Electronics Diagrams (available from the American National Standards Institute, New York, NY)
- ANSI/IEEE Std 91 (1984), Graphic Symbols for Logic Functions (available from the American National Standards Institute, New York, NY).

4. Acronyms and Abbreviations

A. General

(1) The acronyms and abbreviations used by Honeywell are identified in the List of Acronyms and Abbreviations that follows.

List of Acronyms and Abbreviations

Term	Full Term
A/C	aircraft
ABV	above
ACT	altitude compensated tilt
ADC	air data computer
ADF	automatic direction finder
ADI	attitude director indicator
AFCS	automatic flight control system
AHRS	attitude and heading reference system
ALT	altitude
AMM	aircraft maintenance manual
ANSI	American National Standards Institute
AOA	angle of attack
AOSS	after over station sensor
AP	autopilot
APP, APR	approach

Term	Full Term
APT	airport
ARINC	Aeronautical Radio, Inc.
ASCB	avionics standard communication bus
ASCII	American Standard Code for Information Interchange
ASEL	altitude preselect
ASL	above sea level
ASME	American Society of Mechanical Engineers
ATC	air traffic control
ATCRBS	air traffic control radar beacon system
ATT	attitude
baro	barometric
BC	back course
BCD	binary coded decimal
BIT	built-in test
BLW	below
BRG	bearing
CAIMS	Central Aircraft Information Maintenance System
CAP	capture
CAT	category
CCA	circuit card assembly
CCW	counterclockwise
CDU	control display unit
CFIT	controlled flight into terrain
CH	channel
CODEC	coder/decoder
COM	communication
CP	cross pointer
CRT	cathode ray tube
CSDB	commercial standard digital bus

Term	Full Term
CW	clockwise
DAT	data
DAU	data acquisition unit
DC	direct current
DEC	decrease
DG	directional gyro
DGR	degrade
DH	decision height
DIM	dimming
DME	distance measuring equipment
DR	dead reckoning
DTRK	desired track
DU	display unit
EDS	electronic display system
EFIS	electronic flight instrument system
EGPWS	enhanced ground proximity warning system
EIA	Electronic Industries Association
EMER, EMRG	emergency
ENT	enter
ESCI	enhanced serial control interface
ET	elapsed time
FC	fault code
FD	flight director
FIM	fault isolation manual
FL	flight level
FLC	flight level change
FMS	flight management system
FSBY	forced standby

Term	Full Term
ft	foot
ft/min	foot per minute
g	acceleration of gravity
GA	go-around
GAMA	General Aviation Manufacturers Association
GMAP	ground mapping
GPO	Government Printing Office
GPS	global positioning system
GPWS	ground proximity warning system
GS	glideslope
GSPD	groundspeed
HDG	heading
HDLC	high-level data link control
HF	high frequency
HMN	Honeywell material number
hPa	hectopascal
HPN	Honeywell part number
HSI	horizontal situation indicator
I/O	input/output
IAC	integrated avionics computer
IAS	indicated airspeed
IC	integrated computer
ICB	integrated computer bus
ID	identification
IDENT	identifier
IEEE	Institute of Electrical and Electronics Engineers
IF	intermediate frequency
ILS	instrument landing system

Term	Full Term
in.	inch
INC	increase
inHg	conventional inch of mercury
INPH	interphone
INTG	integrity
ISO	International Standards Organization
JAA	Joint Airworthiness Authorities (European)
kg	kilogram
kHz	kilohertz
LAT	latitude
lb	pound
LBS	lateral beam sensor
LCD	liquid crystal display
LED	light-emitting diode
LNAV	lateral navigation
LNDG	landing
LOC	localizer
LON	longitude
LRN	long range navigation
LRU	line replaceable unit
LSB	least significant bit
LSS	lightning sensor system
μA	microampere
MADC	micro air data computer
MAG	magnetic
max	maximum
MDA	minimum descent altitude

Term	Full Term
MDS	minimum discernible signal
MFD	multifunction display
MHz	megahertz
MKR	marker
MLS	microwave landing system
mm	millimeter
Mmo	maximum Mach operation
μs	microsecond
ms	millisecond
MSB	most significant bit
MSG	message
MSL	mean sea level
mV	millivolt
NAV	navigation
NM	nautical mile
NOC	navigation on course
nom	nominal
NORM	normal
NRZ	nonreturn-to-zero
OSS	over station sensor
PAG	page
PAST	pilot-activated self-test
PC	personal computer
PFD	primary flight display
PGE	page
PIT	pitch
POST	power-on self-test
PRF	pulse repetition frequency

Term	Full Term
PTT	push to talk
RA	radio altitude
RCB	radio communication bus
RCL	recall
REACT	rain echo attenuation compensation technique
RF	radio frequency
RIB	remote image bus
RMI	radio magnetic indicator
RMU	radio management unit
RNG	range
RSB	radio system bus
RTA	receiver transmitter antenna
S.I.	International System of Units
SAT	static air temperature
SBY	standby
SC	single cue
SCI	serial control interface
SDI	source/destination identifier
sec	second
SECT	sector
SEL	select
SG	symbol generator
SKP	skip
SLV	slave
SPEX	spares exchange
SQ	squelch
SRN	short range navigation
SSEC	static source error correction
SSM	sign status matrix

Term	Full Term
ST EL	station elevation
STAB	stabilizer
STC	sensitivity time control
std	standard
STO	store
T/O	takeoff
TA	traffic advisory
TACAN	tactical air navigation
TAS	true airspeed
TAT	total air temperature
TCAS	traffic alert and collision avoidance system
TCS	touch control steering
TEMP	temporary
TGT	target alert
TOC	top of climb
TOD	top of descent
TRB	turbulence
TST	test
TTG	time to go
TTL	tuned to localizer
TX	transmitter
V ac	volts, alternating current
V dc	volts, direct current
VANG	vertical angle
VAPP	VOR approach
VAR	variable gain
VBS	vertical beam sensor
VHF	very high frequency
VLSI	very large scale integration

Term	Full Term
Vmo	maximum operating velocity
VNAV	vertical navigation
VOR	VHF omnidirectional range
VS	vertical speed
VTA	vertical track alert
W	watt
WOW	weight on wheels
WPT	waypoint
WSP	word sequence position
WX	weather
WXPD	weather radar picture data
XMTR	transmitter
XTK	crosstrack

SECTION 1
SYSTEM OVERVIEW

1. Overview

A. General

(1) The PRIMUS 1000 Integrated Avionics System is made up of the following subsystems:

- Electronic display system (EDS)
- ADZ-950 micro air data system
- PRIMUS 880 weather radar system
- PRIMUS II integrated radio system
- Flight guidance system
- Autopilot/yaw damper system
- Enhanced ground proximity warning system (EGPWS)
- Traffic alert and collision avoidance system (TCAS II)
- AA-300 radio altimeter system
- LSZ-860 lightning sensor system (LSS) - optional
- KHF-1050 single or dual high frequency (HF) communication system - optional.

(2) The PRIMUS 1000 Integrated Avionics System also gives automatic fault reporting and nonintrusive monitoring of sensor data during on-ground maintenance.

(3) The PRIMUS 1000 Integrated Avionics System is a completely integrated, fail-passive autopilot/yaw damper/flight director and display system that has a full complement of horizontal and vertical flight guidance modes. These include all radio guidance modes, long range navigation (LRN) system tracking, and air data oriented vertical modes.

(4) Three-axis aircraft attitude stabilization and path control is supplied throughout the aircraft's normal flight regime. The automatic path mode commands (flight director) are generated by either of two IC-615 integrated avionics computers (IAC), which integrate the attitude and heading reference, air data, and symbol generator functions into a complete aircraft control system. The single autopilot/yaw damper is located in the pilot's IC-615 IAC.

(5) The PRIMUS 1000 Integrated Avionics System also has provisions for input/output (I/O) and data management with external radio navigation subsystems through digital/serial data bus interfaces (radio systems bus). Additional data management activities that cross the boundaries of the functions listed above include system monitoring, self-test, and failure annunciation. Both IC-615 IACs communicate with each other over a dedicated integrated computer (IC) bus.

(6) Table 1-1 gives the components and part numbers that compose a standard system. Table 1-2 gives optional subsystem components. Figure 1-1 shows a flow diagram for the entire PRIMUS 1000 Integrated Avionics System. Figure 1-2 shows the cockpit layout for the Honeywell equipment, and Figure 1-3 shows component locations.

Table 1-1. System Components

System Component	Qty	Part Number	Honeywell A/C Connector Reference Designator	Cessna A/C Connector Reference Designator
FX-220 flux valve	2	2594484	4/C4	UH301/UH302
MS-560 mode selector	2	7018341-803	8	PI325
AZ-950 micro air data computer (MADC)	2	7030700-71703	9/C9	PN371/PN372
PC-400 autopilot controller	1	7003897-923	11	PI340
SM-200 servo (aileron)	1	4006719-906	12	PC301
SB-201 servo bracket	1	4005842	12A	N/A
SM-200 servo (elevator)	1	4006719-906	13	PT303
SB-201 servo bracket	1	4005842	13A	N/A
SM-200 servo (rudder)	1	4006719-910	14	PT301
SB-201 servo bracket	1	4005842	14A	N/A
RI-553 remote instrument controller	1	7016954-971	23	PI420
RI-552 remote instrument controller	1	7016954-981	C23	
WU-880 weather radar receiver transmitter antenna	1	70121450-801	59	PN841
WC-880 weather radar controller	1	7008471-407	61	PI853
DC-550 display controller (WX/TERR, TCAS)	2	7016986-759	115/C115	PN418
DC-550 display controller (WX, TCAS)	2	7016986-761	115/C115	PN418
MC-800 multifunction display (MFD) controller (WX/TERR, TCAS)	1	7007062- 987	126	PI421
MC-800 multifunction display controller (WX, TCAS)	1	7007062-989	126	PI421
DU-1080 display unit (DU)	3	7023460-05001	130/C130 131	PI423/PI424 PI422
IC-615 IAC (symbol generator [SG]/flight director [FD]/autopilot [AP])	1	7017000-96811 or 7017000-96812	190	J1A (PN363) J1B (PN365) J2A (PN367 J2B (PN369)

Table 1-1. System Components (cont)

System Component	Qty	Part Number	Honeywell A/C Connector Reference Designator	Cessna A/C Connector Reference Designator
IM-600 configuration module	2	7025973-04019	199A, C199A	
IM-600 configuration module (TCAS and category [CAT] 2)	2	7025973-04021	199A, C199A	
IM-600 configuration module (TCAS and Telelink)	2	7025973-04023	199A, C199A	
IM-600 configuration module (TCAS, CAT 2, and Telelink)	2	7025973-04025	199A, C199A	
RCZ-831E communication (COM) unit	2	7510700-766	143/C143	PN521/PN528/ PN518
RM-850 radio management unit (RMU)	2	7012100-805, 7012100-811	144/C144	PI627/PI628
AT-860 automatic direction finder (ADF) antenna	1	7510300-901	158/C158	PC603/PC604
DI-851 distance measuring equipment (DME) indicator	2	7513006-911	163/C163	PI809/PI810
RNZ-850 navigation (NAV) unit (very high frequency [VHF] omnidirectional range [VOR]/DME/ADF)	1	7510100-931, 731	164	J1A (PN611) J1B (PN612)
RNZ-850B NAV unit (VOR/DME)	1	7510100-933, 733	C164	J1A (PN622) J1B (PN623)
CD-850 clearance delivery control head	1	7513000-805	165	PI563
RM-855 RMU	2	7013270-963	144, C144	
AV-850A audio panel	2	7511001-913	160, C160	
RT-300 radio altimeter receiver transmitter	1	7001840-936	20	
CAS 67A TCAS II	1	066-01146-1211	193	
MKV EGPWS	1	965-0976-216-216	238	

Table 1-1. System Components (cont)

System Component	Qty	Part Number	Honeywell A/C Connector Reference Designator	Cessna A/C Connector Reference Designator
AT-300 radio altimeter antenna	2	7003586	21, 22	
TCAS antenna (top)	1	071-01548-0100	--	
TCAS antenna (bottom)	1	071-01548-0200	--	
Global positioning system (GPS) antenna	2	S67-1575-52	150	
AT-860 ADF antenna	1	7510300-901	158	

Table 1-2. Optional System Components

System Component	Qty	Part Number	Honeywell A/C Conn Reference Designator	Cessna A/C Conn Reference Designator
DC-550 display controller (WX, no TCAS)	2	7016986-757	115/C115	PI417/PI418
DL-900 data loader	1	7016600-901	123	--
MC-800 MFD controller (WX/TERR, no TCAS)	1	7007062-991	126	PI421
MC-800 MFD controller (WX, no TCAS)	1	7007062-993	126	PI421
AV-850 audio panel (single HF communication)	2	7511001-915	160, C160	PI565/PI564
AV-850 audio panel (dual HF communication)	2	7511001-917	160, C160	PI565/PI564
KRX-1053 HF communication receiver/exciter	1 / 2	064-01073-0101	78, C78	
KPA-1052 power amplifier	1 / 2	064-01072-0101	250, C250	
KCA-1052 antenna coupler	1 / 2	064-01074-0101	249, C249	
HF antenna	1 / 2	14379	--	
IC-615 IAC (AP/flight management system [FMS]/GPS)	1	7017000-94812	190	J1A (PN363) J1B (PN365) J2A (PN367 J2B (PN369)
IC-615 IAC (FMS/GPS, no AP)	1	7017000-95812	C190	J1A (PN364) J1B (PN366) J2A (PN368) J2B (PN370)
IM-600 configuration module	2	7025973-04018	199A, C199A	
IM-600 configuration module - CAT 2	2	7025973-04020	199A, C199A	
IM-600 configuration module - Telelink	2	7025973-04022	199A, C199A	
IM-600 configuration module - CAT 2, Telelink	2	7025973-04024	199A, C199A	
LP-860 lightning sensor processor	1	7011822-904	145	
AT-850 lightning sensor antenna	1	4057697-901	147	

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Figure 1-1. PRIMUS 1000 Integrated Avionics System Flow Diagram

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Figure 1-2. Cessna Citation XLS Cockpit Layout

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Table 1-3 (Sheet 1). RSB Message Numbers (Normal Mode)

WORD POS	0, 1, 2 NAV Rem	3, 4, 5 RMU COM	6, 7, 8 NAV Rem	9, 10, 11 COM Rem	12, 13, 14 NAV Rem	15, 16, 17 RMU NAV	18, 19, 20 NAV Rem	21, 22, 23 IAC/FMS
1 Low	MSG NO.	MSG NO.	MSG NO.	MSG NO.	MSG NO.	MSG NO.	MSG NO.	MSG NO.
1 High	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL
2 Low	MLS	COM	ADF	COM	MLS	ADF	ADF	ATC
2 High	OUTPUT AZ	OPMODE	REL BRG	STATUS	OUTPUT AZ	OPMODE	REL BRG	OPMODE
3 Low	MLS	COM	ADF	COM	MLS	ADF	ADF	ATC
3 High	OUTPUT GP	CHAN	MAG BRG	CHAN	OUTPUT GP	CHAN	MAG BRG	REPLY CODE
4 Low	MLS	COM	VOR/ILS	COM	MLS	ADF	VOR/ILS	MISC
4 High	AZ DEV	PRESET	BRG/LOC DEV	PRESET	AZ DEV	PRESET	BRG/LOC DEV	STATUS
5 Low	MLS	ATC LEFT	VOR/ILS	COM	MLS	VOR/ILS	VOR/ILS	ATC
5 High	GP DEV	OPMODE	GS DEV		GP DEV	OPMODE	GS DEV	ALTITUDE
6 Low	DME	ATC LEFT	VOR/ILS	COM	DME	VOR/ILS	VOR/ILS	VHF COM
6 High	DIST	REPLY CODE	MARKER		DIST	CHAN	MARKER	OPMODE
7 Low	RT-SIDE	ATC RIGHT	DME DIST	ATC	RT-SIDE	VOR/ILS	DME STA	VHF COM
7 High	DME	OPMODE	RT-SIDE	STATUS	DME	PRESET	FMS A	CHANNEL
8 Low	DIST	ATC RIGHT	PRESET	ATC	DIST	VOR-DME	DME CHAN	VOR/ILS
8 High	FMS A	REPLY CODE	DME DIST	REPLY CODE	FMS A	OPMODE	FMS A	OPMODE
9 Low	DME	ATC/TCAS	LFT-SIDE	ATC	DME	VOR-DME	DME GS	VOR/ILS
9 High	DIST	OPMODE	PRESET	DATA	DIST	CHAN	FMS A	CHANNEL
10 Low	FMS B	ATC/TCAS	DME STATUS	ATC	FMS B	MLS	DME TTS	VOR-DME
10 High	DME	ALT/RANGE	R-S PRESET	ALTITUDE	DME	OPMODE	FMS A	OPMODE
11 Low	DIST	COM STRAPS	DME CHAN	ATC	DIST	MLS	DME STATUS	VOR-DME
11 High	LFT-SIDE	WORD 1	R-S PRESET		LFT-SIDE	CHAN	FMS B	CHANNEL
12 Low	DME STATUS	COM STRAPS	DME GS	ATC/TCAS	DME STATUS	MLS FWD	DME CHAN	MLS-DME
12 High	LFT-SIDE	WORD 2	R-S PRESET	STATUS	RT-SIDE	SEL AZ	FMS B	OPMODE
13 Low	DME CHAN	COM STRAPS	DME TTS	ATC/TCAS	DME CHAN	MLS SEL GP	DME GS	MLS-DME
13 High	LFT-SIDE	WORD 3	R-S PRESET	ALT/RANGE	RT-SIDE	MLS BKWD	FMS B	CHANNEL
14 Low	DME GS	COM STRAPS	DME IDENT	AUX1	DME GS	SEL AZ	DME TTS	FMS A
14 High	LFT-SIDE	WORD 4	R-S PRESET	STATUS	RT-SIDE	RES FOR DME	FMS B	DME OPMODE
15 Low	DME TTS		DME IDENT	AUX1	DME TTS	MLS-DME	MLS	FMS A
15 High	LFT-SIDE		R-S PRESET		RT-SIDE	OPMODE	STATUS	DME CHAN
16 Low	DME IDENT		DME STATUS	AUX1	DME IDENT	MLS-DME	MLS	FMS A

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Table 1-3 (Sheet 2). RSB Message Numbers (Normal Mode)

WORD POS	0, 1, 2 NAV Rem	3, 4, 5 RMU COM	6, 7, 8 NAV Rem	9, 10, 11 COM Rem	12, 13, 14 NAV Rem	15, 16, 17 RMU NAV	18, 19, 20 NAV Rem	21, 22, 23 IAC/FMS
16 High	LFT-SIDE		L-S PRESET		RT-SIDE	CHAN	CHAN	DME OPMODE
17 Low	DME IDENT		DME CHAN	AUX1	DME IDENT	NAV STRAPS	MLS FWD	FMS B
17 High	LFT-SIDE		L-S PRESET		RT-SIDE	WORD 1	SEL AZ	DME CHAN
18 Low	VOR/ILS		DME GS	AUX2	MLS AUX	NAV STRAPS	MLS SEL GP	MLS
18 High	STATUS		L-S PRESET	STATUS	DATA WORD 1	WORD 2	MLS GSTATUS	OPMODE
19 Low	VOR/ILS		DME TTS	AUX2	MLS AUX	NAV STRAPS	MLS BKWD	MLS
19 High	CHAN		L-S PRESET		DATA WORD 1	WORD 3	SEL AZ	CHANNEL
20 Low	VOR/ILS		DME IDENT	AUX2	MLS AUX	NAV STRAPS	MLS BASIC	MLS
20 High	PRESET		L-S PRESET		DATA WORD 2	WORD 4	1,3,4,5,6	FORW/BACK
21 Low	VOR/ILS		DME IDENT	COM CLUSTER	MLS AUX	AHRS-A429	MLS BASIC	
21 High	IDENT		L-S PRESET	STRAPS	DATA WORD 2	NAV HEADING	1,3,4,5,6	MLS GP
22 Low	VOR/ILS	AUX1	ADF	ATC	MLS AUX		MLS BASIC	ADF
22 High	IDENT	OPMODE	STATUS	CONFIG	DATA WORD 3		WORD 2	OPMODE
23 Low		AUX1	ADF	ATC	MLS AUX		MLS BASIC	ADF
23 High			CHAN	CONFIG	DATA WORD 3		WORD 2	CHANNEL
24 Low	NAV CLUSTER	AUX1	ADF	ATC	MLS AUX		MLS	COM CLUSTER
24 High	STRAPS		PRESET	CONFIG	DATA WORD 4		GEN DATA	OPMODE
25 Low	NAV CLUSTER	AUX1	ADF	COM CLUSTER	MLS AUX		MLS	NAV CLUSTER
25 High	STATUS		IDENT	STATUS	DATA WORD 4		GEN DATA	OPMODE
26 Low	NAV CLUSTER	AUX2	ADF	COM CLUSTER				
26 High	STRAPS	OPMODE	IDENT	STRAPS				
27 Low	NAV CLUSTER	AUX2		COM CLUSTER		SYSTEM		
27 High	STRAPS			STRAPS		ON/OFF		
28 Low	NAV CLUSTER	AUX2		COM CLUSTER		POST SYS		
28 High	STRAPS			STRAPS		POST RADIOS		
29 Low	NAV CLUSTER	AUX2	ADF	COM CLUSTER	MLS	MISC CONTRL		
29 High	STRAPS		CONFIG	STRAPS	CONFIG	FMCS CONTR		
30 Low	VOR	COM CLUSTER	ADF	COM	DME	NAV CLUSTER		
30 High	CONFIG	OPMODE	CONFIG	CONFIG	CONFIG	OPMODE		
31 Low	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM
31 High	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM	CHECKSUM

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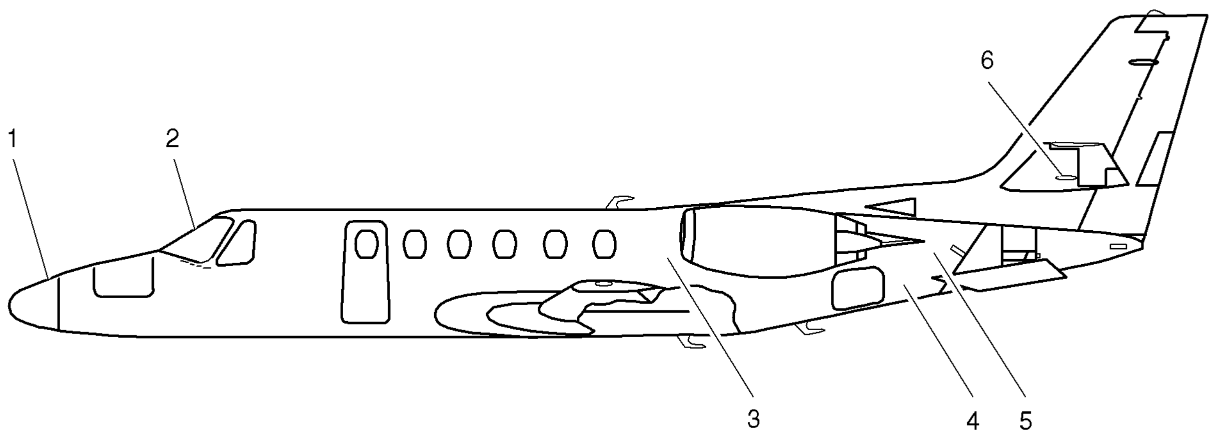

1. NOSE COMPARTMENT COMPONENTS:
   - IC-615 INTEGRATED AVIONICS COMPUTER (IAC)
   - AZ-950 MICRO AIR DATA COMPUTER
   - WU-880 WEATHER RADAR RECEIVER/TRANSMITTER AND ANTENNA UNIT
2. INSTRUMENT PANEL AND PEDESTAL MOUNTED COMPONENTS:
   - DU-1080 DISPLAY UNIT (PFD AND MFD)
   - MS-560 MODE SELECTOR
   - RI-552 REMOTE INSTRUMENT CONTROLLER
   - RI-553 REMOTE INSTRUMENT CONTROLLER
   - DC-550 DISPLAY CONTROLLER
   - PC-400 AUTOPILOT CONTROLLER
   - WC-880 WEATHER RADAR CONTROLLER
   - MC-800 MFD CONTROLLER
3. SM-200 SERVO DRIVE (AILERON)
4. SM-200 SERVO DRIVE (ELEVATOR)
5. SM-200 SERVO DRIVE (RUDDER)
6. FX-220 FLUX VALVES

ID-149234

Figure 1-3. Cessna Citation XLS Component Locations

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2. System Description

A. General

(1) The PRIMUS 1000 system organization is centered around the IAC that performs display and flight guidance functions normally associated with a symbol generator, flight director, and autopilot/yaw damper. These functions are all co-located in the IC-615 IAC on separate circuit card assemblies (CCAs). The IC-615 IAC reduces the number of aircraft LRUs by housing a number of independent functions in one LRU. Some of these functions are managed by dedicated I/O hardware and some are managed by a microprocessor in conjunction with individual commands, switching logic, and drive circuitry. As installed in this aircraft, only the pilot's IC-615 IAC has an autopilot/yaw damper function. Also, depending on the IC-615 IAC installed, the TCAS function is available.

(2) During normal operation, the system displays heading, course, radio bearing, pitch and roll attitude, radio altitude, course deviation, glideslope deviation, to-from, and DME indications. Annunciators displayed denote selected flight director modes. Pitch and roll flight director steering commands, developed by the IC-615 IAC, are displayed on the primary flight display (PFD) in the cockpit. This computed steering information enables the pilot to reach and/or maintain the desired flightpath or attitude.

(3) When the autopilot is engaged and coupled to either the pilot's or copilot's flight director, the aircraft is controlled with the same commands that are displayed on the PFD. When the autopilot is engaged and no flight director modes are active, the aircraft is controlled by the pilot in pitch and roll and by inserting commands through touch control steering (TCS). When AP is engaged the pilot can control via the turn knob and pitch wheel on the PC-400 autopilot controller.

(4) Operation of a specific system component by the IC-615 IAC is dependent upon the system and other aircraft sensor data inputs. The IC-615 IAC uses software tests, in combination with built-in test (BIT) hardware, to detect failures and determine I/O signal validity. Based on the results of these tests, the IC-615 IAC determines if the system is capable of supplying proper display, FD, AP, and YD mode control and/or mode annunciation. System monitoring is active in all modes of operation.

B. Electronic Display System

(1) The EDS is made up of the following LRUs:

- DU-1080 electronic display units
  - PFD for each pilot
  - MFD for both pilots
- IC-615 IAC No. 1 and No. 2
- DC-550 display controller for each pilot
- Two remote instrument controllers
  - RI-553 for the pilot
  - RI-552 for the copilot
- MC-800 MFD controller for both pilots.

(2) The EDS displays pitch and roll attitude, heading, course/desired track orientation, flightpath commands, weather radar presentations, checklists, and selected mode and source annunciators. The displays are organized into dual PFDs and a single MFD.

(3) The PFD combines the attitude director indicator (ADI), horizontal situation indicator (HSI), and air data displays of airspeed, vertical speed, and barometric altitude, as well as mode annunciations into a single display unit. Essential information from sensor systems, navigation, and caution-warning systems are integrated into the pilot's prime viewing area.

(4) Selection of the PFD formats and display intensity is accomplished with the DC-550 display controller. Bearing pointer select functions are also controlled from this controller.

(5) The MFD presents data to the flightcrew that enhances the operation of the aircraft. This data includes normal and emergency checklists, long-range navigation display, and weather radar display. In addition, the MFD has a backup SG capability in case of PFD failure. Selection of MFD formats and checklist operation is accomplished with the MC-800 MFD controller.

(6) When the display system is in its normal (no failure) configuration, IC-615 IAC No. 1 supplies the pilot's display with data and IC-615 IAC No. 2 supplies the copilot's display with data. The IC-615 IAC receives digital and discrete inputs, organizes this information into the correct formats as defined by the display controller, and transmits these formats to the display units. The IC-615 IAC communicates with the display unit over a 1-MHz serial digital databus.

(7) The switching of navigation sensor data for display and flight guidance is done electronically. All comparison monitoring of critical display data is done within the IC-615 IAC. Each IC-615 IAC, even with a partial failure, is capable of supplying its respective PFD and the MFD with data. In the case of a DU-1080 display unit failure, the PFD takes priority over the MFD.

C. ADZ-950 Micro Air Data System

(1) The ADZ-950 micro air data system is made up of the following LRUs/controls:

- AZ-950 MADC No. 1 and No. 2
- BARO set knob and STD button.

(2) The AZ-950 MADC supplies the IC-615 IAC with an ARINC 429 input of barometric corrected altitude, indicated airspeed (IAS), Mach, maximum operating velocity (Vmo), true airspeed (TAS), total air temperature (TAT), static air temperature (SAT), and altitude rate. The BARO set knob allows for pilot input of barometric pressure. The STD button allows for automatic barometric correction settings of either 29.92 inHg or 1013 hPa. The AZ-950 MADC is connected to the pitot/static and outside air temperature probes.

(3) Air data parameters displayed on the PFD are as follows:

- IAS/Mach
- Barometric altitude
- Vertical speed.

(4) Air data parameters displayed on the MFD are as follows:

- TAS
- SAT
- TAT.

D. PRIMUS 880 Weather Radar System

(1) The PRIMUS 880 weather radar system is made up of the following LRUs:

- WU-880 receiver transmitter antenna
- WC-880 weather radar controller.

(2) The weather radar system is an X-band radar designed for weather detection, ground mapping, and analysis. Data is displayed on the PFD and the MFD. Storm intensity levels are displayed in bright colors against a deep black background. Areas of heaviest rainfall appear in magenta, areas that have the next heaviest rainfall appear in red, areas that show medium intensity appear in yellow, and areas with the weakest rainfall appear in green.

(3) In the ground-mapping (GMAP) mode, prominent landmarks are displayed that enable the pilot to identify coastline, hilly and mountainous regions, cities, or even large structures. In GMAP mode, video levels of increasing reflectivity are displayed as black, cyan, yellow, and magenta.

(4) A rain echo attenuation compensation technique (REACT) mode automatically increases receiver gain as a function of attenuation, due to intervening rainfall. At the point where the receiver can no longer detect levels less than red, a blue field is displayed indicating an out-of-calibration region. Target alert (TGT) mode is selected to indicate when level 3 (red) or greater weather is present in a sector beyond the currently displayed range.

(5) For the PRIMUS 880 weather radar system, a turbulence (TRB) mode is used to detect turbulent air in the 10- to 50-NM range. Areas of potentially hazardous turbulence are shown in gray-white. After proper evaluation, the pilot can chart the desired course around these storm areas.

(6) Weather radar mode selection, range, and tilt control are supplied by the WC-880 weather radar controller.

E. PRIMUS II Integrated Radio System

(1) The PRIMUS II integrated radio system is made up of the following LRUs:

- RM-850 RMU
- AV-850A audio panel
- CD-850 clearance delivery control head (tuning backup control head)
- RCZ-851E integrated COM unit
- RNZ-850/850B integrated NAV unit.

(2) The PRIMUS II integrated radio system is a dual, remote-mounted digital radio system that encompasses all standard navigation and communication functions, including VOR, DME, instrument landing system (ILS), and VHF communications. Marker beacon and transponder (mode A/C/S, depending on installation) are also included. All control functions are operated from two RM-850 RMUs. A CD-850 clearance delivery control head is also part of the system. Interface with the TCAS is from the RMU and through the diversity Mode S transponder.

F. Flight Guidance System

(1) The flight guidance system is made up the following components:

- IC-615 IAC No. 1 and No. 2
- MS-560 mode selector.

(2) The PRIMUS 1000 flight guidance system features an IAC concept that combines the normal EDS display function with the flight director function. This level of integration supplies a number of benefits over existing systems and greatly simplifies the interface requirements of the flight director function. This level of integration implies that if the EDS is operational, the flight director is operational. Conversely, if the EDS fails, the flight director also fails.

(3) Input data requirements for the flight director are fully encompassed by the EDS function. By combining the flight director and EDS processors, the flight director I/O hardware and software can be virtually eliminated.

(4) The flight director supplies computed steering commands to the autopilot for display on the PFD. If the autopilot is not engaged, the pilot can manually fly the steering command presented on the PFD. The flight director supplies both lateral (roll) and vertical (pitch) steering commands. One lateral and one vertical flight director mode can be active simultaneously. Other flight director modes can be armed to automatically become active at the proper time.

(5) For the flight director to do its job, it looks at the following:

- The pilot’s desired attitude/position/heading/etc.
- The aircraft’s actual attitude/position/heading/etc.
- If there is a difference between desired and actual data, correct for the difference and control the speed at which the correction takes place.

(6) The flight director computes pitch and roll steering commands based on data from a variety of sources, including the following:

- Air data
- Pitch and roll attitude
- Magnetic heading
- VOR/DME/ILS
- Pilot inputs
- Radio altimeter.

(7) Flight director steering commands supply a key data point in the display and flight director system. These steering commands are output to the following subsystems:

- EDS for pilot display
- Autopilot for automatic flightpath control
- Autopilot monitors.

(8) The IC-615 IAC processes course, selected heading, attitude, air data, DME, and radio navigation data to supply computed pitch and roll steering commands for display on the PFD and for autopilot automatic flightpath steering through control of the flight control surfaces using the SM-200 servo motors.

(9) Flight director mode selection and annunciation is through mode select buttons on the MS-560 mode selector. The flight director command cue on the PFD also reflects the selected mode.

(10) Flight director couple switching between the pilot's and copilot's flight director is through a couple switch.

G. Autopilot/Yaw Damper System

(1) The autopilot/yaw damper system is made up of the following LRUs:

- IC-615 IAC (pilot's side only)
- PC-400 autopilot controller
- SM-200 servos (aileron, elevator, and rudder).

(2) The PRIMUS 1000 system autopilot is a fail-passive design, featuring digital attitude and servo loops. The autopilot supplies aircraft stabilization and tracking of pitch and roll steering commands from the flight director. The autopilot is not aware of which flight director mode(s), if any, are active. The autopilot simply tracks the pitch and roll steering commands from the selected flight director as attitude changes.

(3) The yaw damper supplies yaw rate damping only, and makes no effort to control the flightpath of the aircraft. Servo position reference is synchronized to zero at engagement and is constantly washed out, ensuring that steady-state rudder forces are zero. If the rudder trim position changes due to pilot input or aircraft configuration changes, the rudder washes out the steady-state force and allows rudder servo resynchronization.

(4) The autopilot/yaw damper monitors are capable of disengaging the autopilot and yaw damper as an independent function. Data used in the autopilot/yaw damper computations are processed in a manner consistent with autopilot flight-safety requirements, while also maximizing autopilot availability. The autopilot/yaw damper engage and disengage process is also monitored, ensuring that the actual engage situation at the servos correctly reflects the engage function status in software.

(5) The pitch axis autopilot trim function works to maintain the aircraft attitude against long-term attitude disturbances such as fuel burn and passenger movement.

(6) For the autopilot to do its job, it looks at the following:

- The pilot's desired attitude
- The aircraft's actual attitude
- If there is a difference between desired and actual data, correct for the difference and control the speed at which the correction takes place.

(7) The autopilot and yaw damper engagement is accomplished through the PC-400 autopilot controller. Basic roll and pitch movements can be manually made using the PC-400 TURN knob and PITCH wheel.

H. Enhanced Ground Proximity Warning System

(1) The purpose of the EGPWS is to prevent accidents caused by controlled flight into terrain (CFIT) or severe windshear. The non-Honeywell EGPWS computer receives various aircraft parameters and provides warning annunciations on the PFD and mode annunciations and graphical terrain data on the MFD. The system receives inputs from the following Honeywell LRUs:

- Navigation computer (FMS) that is part of the IC-615 IAC
- RT-300 radio altimeter receiver transmitter
- Attitude and heading reference system (AHRS)
- AZ-950 MADC.

I. Traffic Alert and Collision Avoidance System

(1) The TCAS supplies added protection against collisions with other aircraft by interrogating air traffic control (ATC) transponders on aircraft in the vicinity and analyzing the replies. The potential collision threat level is determined and presented aurally/visually to the flightcrew.

J. AA-300 Radio Altimeter System

(1) A single radio altimeter system supplies absolute altitude to the PRIMUS 1000 Integrated Avionics System. Radio altitude is displayed on both the pilot and copilot PFDs.

K. LSZ-860 Lightning Sensor System (Optional)

(1) The LSZ-850/860 LSS detects and computes the location and vertical lightning strike rate of up to 50 thunderstorm areas within 200 NM around the aircraft. The LSS tracks the range and bearing of each lightning discharge. Three distinct levels of vertical lightning rate are computed for display. Each symbol represents a specific rate of vertical lightning activity that has occurred in the last 2 minutes over a circular area. The circular area diameter varies depending on the range of the targets.

L. KFH-1050 HF Communication System (Optional)

(1) The KHF-1050 HF communication system is a voice and data communication system. It operates in a frequency range between 2.0 and 29.9999 MHz with several different emission modes to provide voice communication. A configuration is called a dual system when two KHF-1050 HF communication systems are installed in the same aircraft to share one antenna. Both systems can receive simultaneously, but only one system is chosen to transmit at any one time. An auto select transmit scheme determines which system is selected to transmit.

3. Digital Data Buses

A. General

(1) An essential function of the PRIMUS 1000 Integrated Avionics System is information interchange between subsystems and/or between LRUs within a subsystem.

(2) Some of this information is in the form of discrete data. Discrete data is carried on a single wire and typically switches between +28 V dc and open, or between ground and open. This switched data is used for annunciators, warnings, and anywhere simple condition information is sufficient. This is a small portion of the total information interchange.

(3) Most of the information transfer between subsystems is through the use of digital data buses. The data buses found in the PRIMUS 1000 Integrated Avionics System include the following:

- Radio system bus (RSB)
- Digital audio bus
- Commercial standard digital bus (CSDB)
- ARINC 429
- RS-422
- RS-232
- Serial control interface (SCI)
- Weather radar picture data (WXPD)
- Integrated computer bus (ICB)
- Symbol generator/display unit bus.

(4) The paragraphs that follow describe the operation and uses of each of these buses.

B. RSB

(1) The Honeywell RSB, as shown in Figure 1-4, is the principal communications network, interconnecting the LRUs in the PRIMUS II integrated radio system. All the LRUs in the radio system, except the audio panels, are connected to the RSB. Specific details regarding the operation of the radio system are covered elsewhere in this manual.

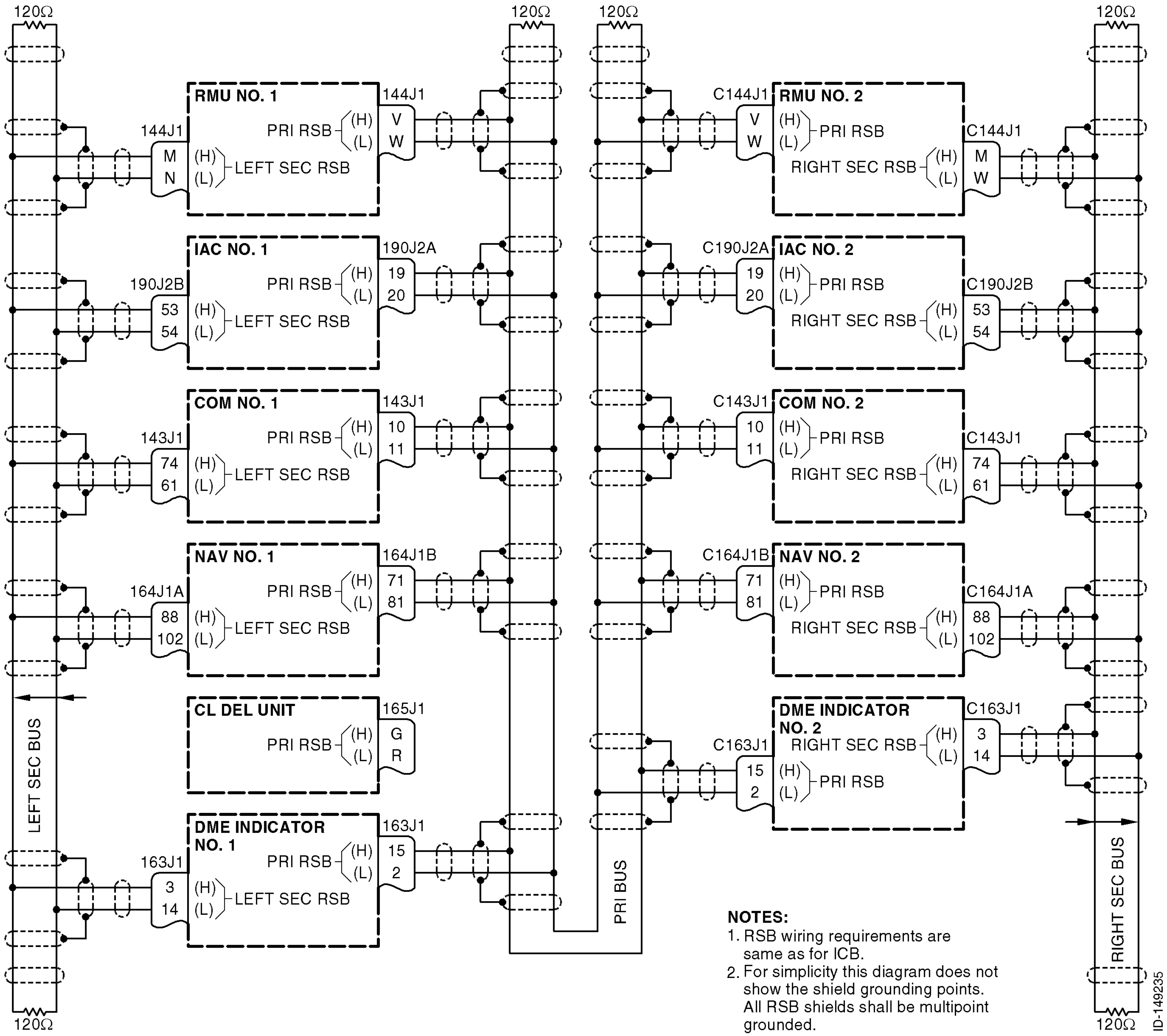

Figure 1-4. Radio System Bus

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(2) Reliable transfer of data using the RSB is ensured by designed-in redundancy and predefined protection and isolation mechanisms. Control and data protocols are also predefined to ensure consistent application of the data bus. It is a fail-operational data bus system and actually consists of three shielded twisted pairs. These are the primary bus, left-side secondary bus, and right-side secondary bus. Fail-operational means that if any device connected to the bus fails, the bus remains operational.

(3) All units connected to the RSB (RMU, IAC, remote NAV unit, etc.) are defined as users. The RSB users are all transformer-coupled and impedance-matched to the data bus transmission lines. The bus is a shielded twisted pair, which is differentially driven. Data transmitted onto the bus drives one line more positive, and the other line more negative. This interface method supplies protection from faults, transients, and radio frequency (RF) interference. By design, the RSB interfaces are virtually immune to lightning-induced transients, hot shorts, ground shorts, and RF threats. The design precludes any fault propagation (via RSB) between the various interconnected users. At the same time, the RSB interconnect structure supplies superior RF emissions characteristics, ensuring that RSB does not interfere with sensitive receivers onboard the aircraft. The users are connected to the data buses via a splicing arrangement (using solder rings), which experience has shown to be extremely reliable and damage resistant. The type of cable that is specified for use meets regulatory guidelines for flammability and smoke, and is resistant to hydraulic fluids and fuel.

(4) Data flow on the RSB is bidirectional with a bit transmission rate of 2/3 MHz (1.5 μs/bit). Data traffic flow on the RSB does not require a bus controller. All users receive and identify all bus data. Since each user knows its own user number, it sets up an internal timer, based upon the last message received, and transmits at the appropriate time. Each RSB user (other than those described as listen only) outputs its message on the primary and its onside secondary buses simultaneously. This arrangement gives each user dual-path access to its own side data and single-path access to all cross-side data. It also makes it impossible for any single-point fault (such as a fire-ax or a projectile) to disable all three data buses. For example, a failure of the primary bus merely disables cross-side tuning of the radios, and causes no other problems.

(5) The clearance delivery control head and the IC-615 IAC are listen-only devices. They do not transmit on the RSB.

(6) Each bus user's transmitters are safety interlocked, ensuring no user broadcasts outside its allotted timeslot or in response to another user's request. The user interlock mechanisms effectively keep the bus users from competing for simultaneous bus time windows, thereby ensuring reliable data flow.

(7) A field is defined as a 192-ms time period that contains a sequence of 24 messages spaced 8 ms apart, starting with message 0 (transmits address 0) and progressing in sequence to message number 23. Thus, there are 24 possible message timeslots for this bus.

(8) As shown in Figure 1-5, in the message 0 timeslot, the left side NAV unit transmits on both the primary and left-side secondary buses. Then, in the message 1 timeslot, the right-side NAV unit transmits on both the primary and right-side secondary buses. There is a spare timeslot (message 2) for future expansion. Since some messages combine data from more than one radio function, RMU, COM, transponder, VOR/localizer (LOC), glideslope, marker, DME, ADF, and microwave landing system (MLS) require eight messages per system side. Left side system = 8, right side system = 8, and spare timeslots = 8 more, totaling 24.

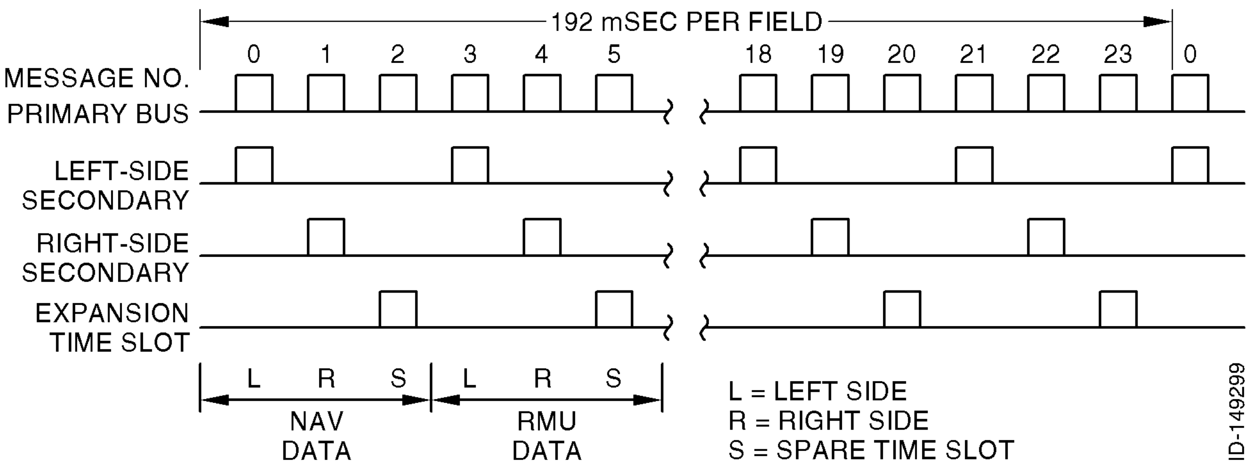

Figure 1-5. RSB Data Field Structure

(9) When message number 23 is complete, the cycle begins again with message number 0, and the cycle repeats for as long as the system has power applied. During initial power-up, the RMUs are programmed to start the bus activity by transmitting messages 3 or 4, depending on which RMU comes on line first. The sequence of transmissions is fixed, and any LRU user that is not installed in the aircraft still has a timeslot assigned at the appropriate time in the field. Therefore, removal of a unit does not disable the bus functions.

(10) Table 1-3 gives the message content for each message in the sequence in the normal operational mode.

(11) The data format of the messages on the RSB is similar to high-level data link control (HDLC). This format is described by International Standards Organization (ISO) 3309-1979 (E).

C. Digital Audio Bus

(1) The PRIMUS 1000 system uses a digital data bus to carry digital audio information from the remote radio system LRU to the flightcrew's audio panels. Digitizing the audio offers the advantage of complete independence from grounding problems within the aircraft and the absolute elimination of ground noise pick-up, whine, and cross-talk.

(2) Each side has a one-way digital audio bus made up of a shielded twisted pair that is differentially driven, feeding up to four audio panels. Data transmitted onto the bus drives one line more positive and the other line more negative. This interface method supplies protection from faults, transients, and RF interference. By design, the interfaces are virtually immune to lightning-induced transients, hot shorts, ground shorts, and RF threats. The design precludes any fault propagation (via digital audio bus) between the various interconnected users. At the same time, the digital audio bus interconnect structure supplies superior RF emissions characteristics, ensuring the digital audio bus does not interfere with sensitive receivers onboard the aircraft. The users are connected to the data buses by a splicing arrangement (using solder rings), which experience has shown to be extremely reliable and damage resistant. The type of cable that is specified for use meets regulatory guidelines for flammability and smoke, and is resistant to hydraulic fluids and fuel.

(3) Each remote LRU contains a cluster module that is made up of five digitizer chips. These are standard off-the-shelf chips (called CODECs - for COder/DECoder) that are used by many telephone companies. The five digitizers are sampled in sequence, their digital outputs are assembled into a digital data message, and the message is transmitted on the digital audio bus.

(4) The remote COM units supply digitized COM receive audio, and the remote NAV units supply digitized VOR/LOC, ADF, and marker beacon audio. The NAV units also feed discrete digital bits (in a status byte) to enable an audio oscillator in the audio panel when MLS or DME Morse code identifier audio is present. Both remote units contain additional unassigned digitizers for future growth, one of which is frequently used for high frequency received audio.

(5) The two separate digital audio buses are fed to all audio panels for flightcrew selection. This allows the flightcrew to select and control each individual audio source. Data flow on the digital audio bus is unidirectional with a bit transmission rate of 1.0 MHz (1.0 μs/bit). Data traffic flow on the digital audio bus does not require a bus controller. The COM unit transmits a data string of approximately 60 μs every 128 μs (see Figure 1-6). The NAV unit receives the COM message, synchronizes its transmitter, and transmits the approximately 60 μs NAV message immediately after the COM message. Should the COM unit fail, the NAV unit goes into a free run mode so as not to lose the NAV digital audio.

(6) In each transmitted message, the preamble consists of 8 ± 1 Manchester one bits; the sync consists of 1 1/2 bits of HIGH followed by 1 1/2 bits of LOW, which the receiver uses for synchronization. The remaining six bytes contain eight bits each, at 1.0 μs/bit. The status byte identifies the message as COM or NAV. The digital audio panel then decodes and processes the individual bytes as appropriate to the flightcrew selections.

(7) The digital audio bus is very similar to the RSB. The clock frequency is 1 MHz instead of 2/3 MHz, and the data bit assignments are different. Refer to the explanation associated with Figure 1-6 thru Figure 1-9.

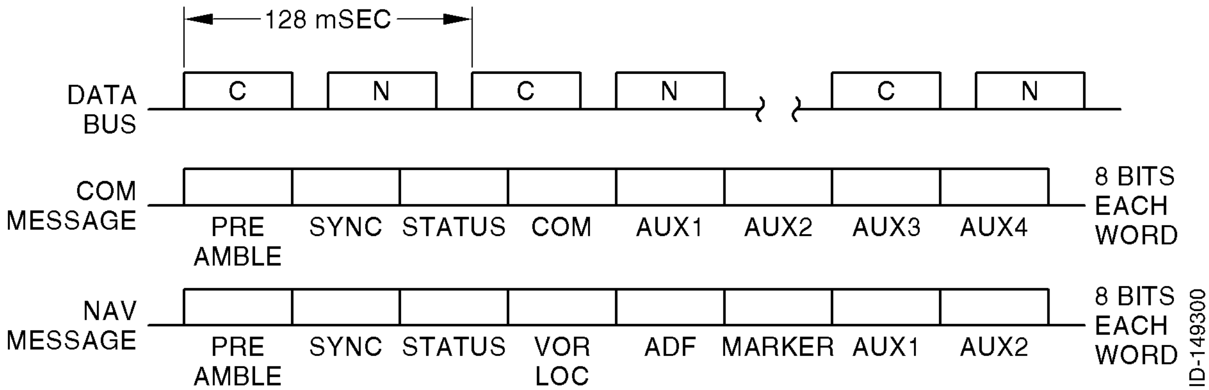

Figure 1-6. Digital Audio Data Sequence

D. CDSB

(1) The PRIMUS 1000 system uses CSDBs for some data handling. For example, backup VOR/LOC/glideslope (GS)/marker (MKR) navigation display data is sent to the RMUs from the No. 2 NAV unit on the CSDB.

(2) The CSDB system is made up of transmitters and receivers connected by shielded twisted pairs. Data is transmitted by a single transmitter to either a single receiver or a group of up to 20 receivers connected in parallel. Each CSDB carries data in one direction only. Bidirectional transmission between two LRUs must be accomplished by using two sets of transmitters, receivers, and twisted-wire-pair buses.

(3) The data format is in accordance with Collins Standard 523-0772774-00611R, CSDB. This data bus is frequently referred to as the Collins Pro-Line II Serial Data bus, or simply PL-II.

E. ARINC 429

(1) The PRIMUS 1000 system uses ARINC 429 data buses for most of the data handling. For example, MADC data is transmitted from/to various units on ARINC 429 buses.

(2) The 429 bus system is made up of transmitters and receivers connected by shielded twisted wire pairs. Data is transmitted by a single transmitter to either a single receiver or to a group of up to 20 receivers connected in parallel. Each 429 bus carries data in one direction only. Bidirectional transmission between two LRUs must be accomplished by using two sets of transmitters, receivers, and twisted-wire pair buses.

(a) Field Definitions

1 ARINC 429 transmissions consist of words made up of 32 bits. These words are transmitted at either 12.5 kHz (low speed) or 100 kHz (high speed), depending on the system. Bit number 1 is always the first bit transmitted, and bit number 32 is always the last bit transmitted. Bits 1 thru 8 are called the octal label, which identifies the type of information contained within the word. For example, true airspeed has an octal label of 210. In most cases, bits 9 and 10 are the source/destination identifier (SDI), which indicates the source LRU in multibox installations by system number (1 thru 4). Bits 9 and 10 may also be used as data bits in high resolution data words. Bits 11 thru 29 compose the data field. Bit 11 is the least significant bit (LSB) and bit 29 is the most significant bit (MSB). In most cases, bits 30 and 31 form the sign status matrix (SSM), which identifies the sign and validity of the data. Like bits 9 and 10 above, bits 30 and 31 may also be used as data bits in high resolution data words. Bit 32 is used for parity.

(b) Label – Bits 1 thru 8

1 In the octal label, bits 1 thru 8 are used to represent numbers 0 thru 377. The eight bits are broken into two groups of three and one group of two. Each group represents a digit encoded in binary with the LSB having a value of one. The octal label is transmitted with the MSB of the most significant digit first. This reversed label characteristic is a legacy from past systems in which octal coding of the label field was apparently of no particular significance. Figure 1-7 shows the data bit format for octal label 274.

BIT NUMBER	8	7	6	5	4	3	2	1	
BINARY VALUE	1	2	4	1	2	4	1	2	
LSB	0	0	1	1	1	1	0	1	MSB
CHARACTER VALUE		4			7		2		

ID-149236

Figure 1-7. Octal Label 274

(c) Data Field – Bits 11 thru 29

1 Units, ranges, resolution, refresh rate, and number of significant bits for information transferred are encoded in either binary coded decimal (BCD), or binary notation. Discrete information is also sent over the ARINC 429 bus. In the data field, bits 11 thru 29 are the data bits (see Figure 1-8). For some high resolution data words, bits 9 and 10 and 30 and 31 are also data bits.

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
MSB									DATA									LSB

ID-149301

Figure 1-8. Data Field (Bits 11 thru 29)

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2 If bits 11 thru 29 contain data bits in a binary format, the most significant bit of the data field represents one half of the maximum possible of the value transmitted. Each successive (less significant) bit represents one half of the previous (more significant) bit. Negative numbers are encoded as the two's complement of positive values, with the negative sign reflected in the sign/status matrix.

3 For example, if we wish to encode a quantity whose maximum value is 2500, bit number 29 would represent a value of 1250, bit number 28 would represent a value of 625, bit number 27 would represent a value of 312.5, and so on to bit number 11 that would represent a value of 0.004768371541. Adding up the individual bit values yields the total value of the quantity being transmitted.

4 If bits 11 thru 29 contain data bits in a BCD format (see Figure 1-9), the data is grouped into four bit bytes, each byte denoting a decimal column. The 19 data bits are broken up into four groups of four bits and one group of three bits. Each group of four can represent a number from 0 to 9; the fifth group can represent a number from 0 to 7. Refer to the following examples of BCD data fields. Data bit number 11 (the eleventh bit transmitted in a word) has the binary value of 1. Data bits numbered 12, 13, and 14 have the arithmetic value of 2, 4, and 8 respectively. Each group of bits 15 thru 29 have similarly assigned values as shown in Figure 1-9. Using this format, decimal numbers (or characters) between 0 and 9 can be assembled using combinations of these four binary values.

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
MSB DATA			DATA				DATA				DATA				DATA LSB			

ID-149302

Figure 1-9. BCD Bit Assignments

5 In the data field, only those bits that are required to transmit parameter range and resolution are used, and the remaining bits are set to 0 (zero). For example, Figure 1-10 shows the data word for selected course, with an octal label of 024, and a value of 254 degrees, which only requires three characters. The remaining two characters are filled with zeros. Figure 1-11 shows a DME data word that requires five characters.

PARAMETER: SELECTED COURSE OCTAL LABEL: 024 VALUE: 254 DEGREES

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
2			5				4				X				X			

ID-149303

Figure 1-10. Selected Course Data Word

PARAMETER: DME DISTANCE OCTAL LABEL: 201 VALUE: 257.86 NM

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
0	1	0	0	1	0	1	0	1	1	1	1	0	0	0	0	1	1	0
2			5				7				8				6			

ID-149304

Figure 1-11. DME Distance Data Word

6 Figure 1-12 shows a position data word requiring six characters. As can be seen, bits 9 and 10 are used, and the format is changed slightly.

PARAMETER: PRESENT POS. LONG. OCTAL LABEL: 011 VALUE: E 175° 59.9'

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
1	0	1	1	1	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1
1	7				5				5				9				9			

ID-149305

Figure 1-12. Present Position Longitude Data Word

(d) Sign Status Matrix (Bits 30 and 31)

1 When bits 30 and 31 are being used for the SSM function, the bits assignments are as shown in Table 1-4.

Table 1-4. Sign Status Matrix Bit Assignments

Bit		Meaning
31	30	
0	1	No computed data
1	0	Functional test
0	0	Plus, north, east, right, to, above
1	1	Minus, south, west, left, from, below

2 In data words that are BCD encoded for longitude and latitude, bits 30 and 31 are both encoded to zeros for east or north, or both to ones for west or south. Bits 9 and 10 are not used for SDI, but are included in the data field to give the resolution required for position.

3 For angular range, 0 thru 359.xxx degrees is encoded as 0 thru ±179.xxx degrees. The sign bits (30 and 31) determine the semicircle being referenced. The positive portion of the semicircle includes 0 thru 179.xxx degrees. The negative portion includes 180 thru 359.xxx degrees. An all zeros configuration represents 0 and 180 degrees. All ones represents 179.xxx and 359.xxx degrees. Two's complement notation is used for the negative half.

(e) Parity (Bit 32)

1 Parity is one of the simplest of all the error checking methods used in data handling. There are two basic parity configurations, odd and even. ARINC 429 transmissions are always odd parity, and bit 32 is the parity bit. ARINC 429 receivers are programmed to always expect an odd number of binary 1s in each 32-bit word. Bit 32 is set to 1 (one) when there are an even number of binary 1s in the word, and set to a 0 (zero) when there are an odd number of binary 1s in the word. This creates a word that always contains an overall odd number of 1s.

(f) Waveform Parameters

1 To be compatible with the transformer-coupled data bus, all ARINC 429 messages are Manchester II encoded before being applied to the bus. Unlike nonreturn-to-zero (NRZ) data, which requires a bandwidth of dc to f_c (clock frequency), Manchester encoded data is limited to the frequency range of $f_c/2$ to f_c. Also, since Manchester data must transition in the middle of each bit period, the data clock is contained within the data and is easily extracted at each receiver for data decoding. This feature avoids having to send a synchronous clock on separate lines along with the data.

2 ARINC 429 transmissions return to the zero voltage condition at the end of each bit period. As shown in Figure 1-13, a high on Line A, and a low on Line B is a binary one. In addition, a low on Line A, and a high on Line B is a binary zero. When both Line A and Line B are at zero volts, there is no data bit being transmitted. ARINC 429 transmitters must supply a minimum dead time of four bits between messages because the receivers synchronize to the transmitted data by recognizing the four-bit dead time as the synchronizing command.

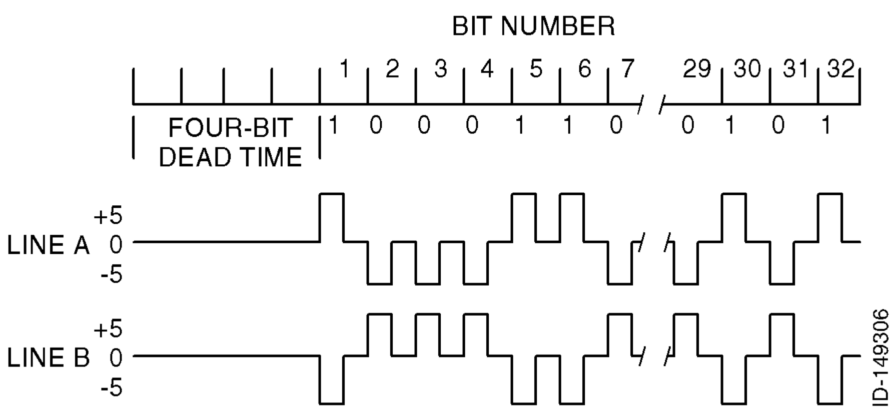

Figure 1-13. ARINC 429 Transmission Waveforms

3 Tri-level bipolar modulation consisting of HI (binary one), LO (binary zero) and NULL (no data) states are used in the transmission of data. The differential output signal voltage across the specified output terminals (balanced to ground at the transmitter) should be as given in Table 1-5 when the transmitter is open circuit.

Table 1-5. Transmission Waveform Voltages

	HI (1)	NULL (V)	LO (0)
Line A to Line B	+10 ± 1.0	0 ± 0.5	–10 ± 1.0
Line A to ground	+5 ± 0.5	0 ± 0.25	–5 ± 0.5
Line B to ground	–5 ± 0.5	0 ± 0.25	0 ± 0.25

4 The differential voltage presented at the receiver is dependent upon line length and the number of receivers connected to a transmitter. The nominal voltage range at the terminals is likely to be between 6.5 and 13 volts peak-to-peak. Receiver input common mode voltages (Line A to ground and Line B to ground) are not specified because of the difficulties of defining ground with any satisfactory degree of precision.

5 The transmitter output impedance is 75 ohms balanced to ground. The receiver input impedance is typically 8,000 ohms. No more than 20 receivers (400 ohms minimum for 20-receiver loads) should be connected to one digital data bus, and each receiver contains isolation provisions, ensuring that the occurrence of any reasonably probable failure on one bus does not cause loss of data to the others. Bus fault tolerances for shorts and steady-state voltages are designed into the transmitters and receivers.

F. RS-422

(1) RS-422 refers to an electrical specification defined by the Electronic Industries Association (EIA). The term RS-422 is used throughout this manual to describe any data bus that consists of shielded twisted pairs. Some examples are:

- The bus that carries data from the integrated avionics computers to the display units
- The bus that carries data from the weather radar receiver transmitter to the display units.

G. RS-232

(1) Like the RS-422, RS-232 also refers to an electrical specification as defined by EIA. It is used throughout this manual to describe any of the buses that are used to connect to a personal or laptop computer. This data bus typically carries ASCII data between the computer and one or more of the LRUs in the PRIMUS 1000 system. An example is the link between the personal or laptop computer and the IAC test function.

H. SCI

(1) The mode, range, tilt, gain, and controller switch data is sent from the WC-880 radar controller to the WU-880 receiver transmitter antenna (RTA). This data is sent over the SCI bus to the IC-615 IACs.

I. WXPD

(1) The WXPD bus is a 1-MHz dedicated digital bus that interfaces with the RTA, MFDs, and PFDs. Picture data video information is supplied from the RTA to the MFDs and PFDs.

J. ICB

(1) The ICB is a 1-MHz bus used for communication between the IC-615s. This bus operates on the HDLC hardware interface. The IC-615 uses this bus for the following:

- Reception of data from the cross-side IC-615
- Transmission of data to the cross-side IC-615.

(2) This data bus allows communication between the left and right IACs and loading of software into the IACs.

K. Symbol Generator/Display Unit Bus

(1) The IACs contain a 1-MHz symbol generator/display unit or picture bus that is used to transmit display formats to the PFDs and the MFD. This bus operates on the HDLC interface.

(2) Each format transmission is encoded with an identifier specifying which display (PFD or MFD) is required to display the format.

(3) Each IAC transmits data to the DU-1080s at a transmission rate of every 33.3 ms (a 30-Hz update rate), although not all the data for a complete format is sent each time. Some data is updated at slower rates, multiplexed in the 30-Hz transmissions.

SECTION 2
SYSTEM DESCRIPTION

1. Overview

A. General

(1) This section gives a detailed description of the general operation and cockpit displays for the PRIMUS 1000 Integrated Avionics System. The operation and display descriptions of the PRIMUS 1000 Integrated Avionics System subsystems are presented in subsections. Each subsection includes interface diagrams, outline illustrations, and tables of leading particulars for each LRU. The subsections are given in Table 2-1.

Table 2-1. System Description Subsections

Sub Section	Subsystem	Page Number
2-1	Electronic Display System	2-1-1
2-2	ADZ-950 Micro Air Data System	2-2-1
2-3	PRIMUS 880 Weather Radar System	2-3-1
2-4	PRIMUS II Integrated Radio System	2-4-1
2-5	Flight Guidance System	2-5-1
2-6	Autopilot/Yaw Damper System	2-6-1
2-7	Enhanced Ground Proximity Warning System	2-7-1
2-8	Traffic Alert and Collision Avoidance System	2-8-1
2-9	AA-300 Radio Altimeter System	2-9-1

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SECTION 2-1
ELECTRONIC DISPLAY SYSTEM

1. Overview

A. General

(1) The PRIMUS 1000 Integrated Avionics System includes an EDS with the following LRUs:

- Two IC-615 IACs
- Three DU-1080 DUs
- Two DC-550 display controllers
- One RI-553 remote instrument controller
- One RI-552 remote instrument controller
- One MC-800 MFD controller.

(2) Two DUs are used to display primary flight data and are called PFDs. One DU is used to display multifunction data and is called an MFD.

(3) The EDS is a completely integrated system that combines the processing of primary flight display data with flight guidance data. This level of integration supplies a number of cost and weight benefits over traditional avionic systems, and greatly simplifies the interface requirements for the flight director. The manner of integration also implies that if the EDS is operational, the flight director is also operational, and conversely if the EDS fails, the flight director also fails. This approach features all the performance advantages of display integration, flexibility, redundancy, and reliability.

(4) The EDS displays the following information in the prime viewing area on both the pilot's and copilot's PFD:

- Pitch and roll attitude
- Indicated airspeed
- Barometric altitude
- Selected alert altitude
- Heading
- Course/desired track orientation
- Vertical speed
- Flight director commands
- Mode and source annunciators.

(5) The MFD supplies the pilot or copilot with a variety of displays that are menu driven. The menu selections for the buttons are shown at the bottom of the MFD. The menu selections change as a function of whichever mode is selected for display. Checklist operation, symbol generator reversionary switching, and TCAS mode selection is accomplished with the MC-800 MFD controller. The MFD display formats include the following:

- Map display for FMS navigation
- Plan display for FMS navigation
- Weather radar display
- TCAS data, if available
- Electronic checklist
- Weather radar data window
- TAS groundspeed (GSPD) window
- Wind display.

2. Component Descriptions and Locations

A. IC-615 IAC

(1) Two IC-615 IACs are located in the nose compartment of the aircraft. Figure 2-1-1 shows a graphical view of the IC-615 IAC. Table 2-1-1 gives items and specifications particular to the IC-615 IAC.

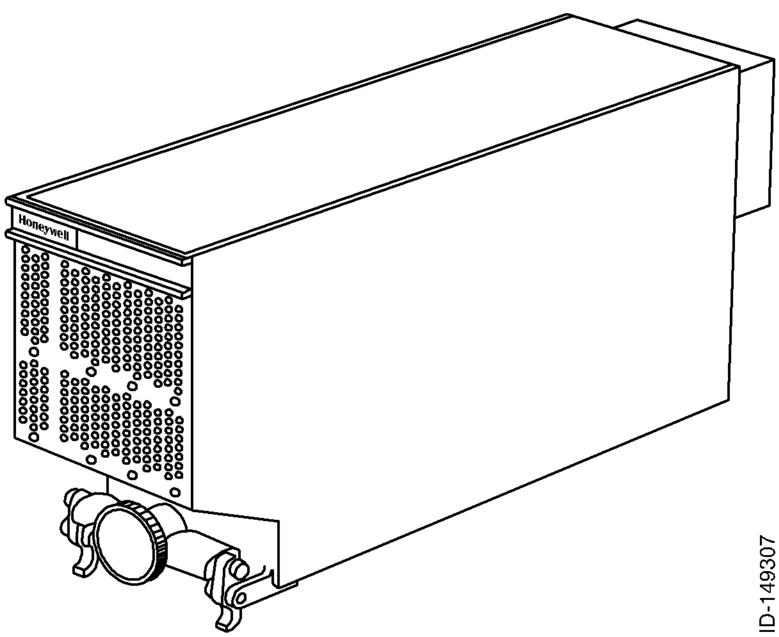

Figure 2-1-1. IC-615 IAC

Table 2-1-1. IC-615 IAC Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	7.62 in. (193.55 mm)
• Width	4.13 in. (104.90 mm)
• Length	16.45 in. (418.83 mm)
Weight (maximum):	
• With autopilot	15.5 lb (7.05 kg)
• Without autopilot	15.0 lb (6.82 kg)
Power requirements (with autopilot):	
• Continuous	28 V dc, 50 W (max)
• In-rush	28 V dc (0.5 sec), 200 W (max)
• Servo power	28 V dc, 210 W (max)/112 W (nom)
Power requirements (without autopilot):	
• Continuous	28 V dc, 50 W (max)
• In-rush	28 V dc (0.5 sec), 200 W (max)
User replaceable parts	
• Battery	HPN 7020116-1
Mating connectors (J1, J2)	ITT Cannon Part No. DPX2MA-A106P-A106P-33B-0001 NOTE: Sunbank backshell (4) required: Part No. J1560-12-2
Mounting	HPN 7017095-902

(2) The IC-615 IAC is the primary LRU of the EDS. The pilot's IC-615 IAC is a symbol generator, flight director, and autopilot/yaw damper computer integrated into a single unit. The copilot's IC-615 IAC is a flight director and symbol generator only. Integrating the autopilot control and flight director functions with the symbol generator eliminates the external interfaces between these computers. All aircraft sensors and navigation sources are connected directly to the IC-615 IAC since all flight control functions reside inside the IAC.

(3) The IC-615 IAC is the focal point of information flow in the EDS. Its primary task is to convert a variety of sensor data into digital data (word) formats for storage in memory until the data can be transmitted over a 1-MHz serial (EDS) bus to the PFD and MFD. Control signals from the display are used by the symbol generators contained within each display unit to select display format and information source. The system architecture also allows comparison monitoring to be performed continuously in the IC-615 IAC, eliminating the need for a separate comparison monitor.

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(4) Information processed in the symbol generator includes attitude (pitch and roll), heading, glideslope, localizer, course deviation, bearing (ADF, FMS, and NAV), and selected air data quantities.

(5) The IC-615 IAC features a distributed processor architecture that uses independent hardware elements to perform the aircraft control and monitor functions. The architecture is designed around functional CCAs. These separate assemblies are the power supply, analog interface, digital interface, primary central processing unit, and autopilot. The autopilot CCA is not installed in the copilot's IC-615 IAC. The two IC-615 IACs communicate with each other via the IC bus, which is a bidirectional, high-speed data bus.

B. DU-1080 DUs

(1) Three DU-1080 DUs are mounted in the aircraft instrument panel. Figure 2-1-2 shows a graphical view of the DU-1080 DU. Table 2-1-2 gives DU configurations, and Table 2-1-3 gives items and specifications particular to the display unit.

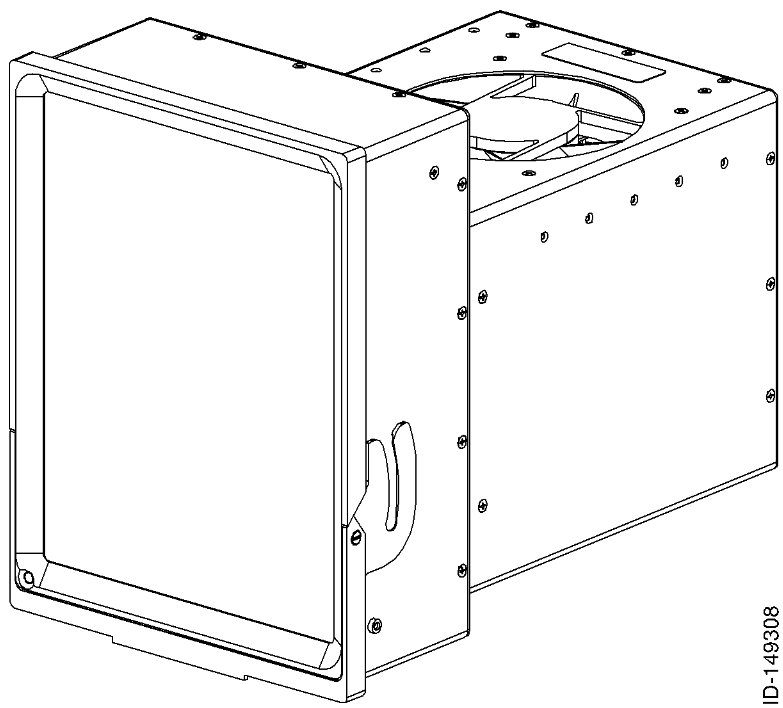

Figure 2-1-2. DU-1080 Display Unit

Table 2-1-2. DU-1080 Display Unit Configurations

Display Unit Part Number	Description
7023460-03001	8- by 10-inch flat panel full-color liquid crystal display (LCD) with gray case and carrying handle. Operates in hybrid mode using stroke writing for symbology and raster scanning for background shading and weather radar/terrain information.
7023460-02001	8- by 10-inch flat panel full-color LCD with black case and carrying handle. Operates in hybrid mode using stroke writing for symbology and raster scanning for background shading and weather radar/terrain information.

Table 2-1-3. DU-1080 Display Unit Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	10.125 in. (257.17 mm)
• Width	7.7 in. (195.58 mm)
• Length	11.953 in. (303.86 mm)
Weight (maximum)	20.0 lb (9.1 kg)
Power requirements:	
• Nominal	28 V dc, 136 W
• Maximum	28 V dc, 177 W
User replaceable parts	None
Mating connectors:	
J1, J2	HPN 7025399-62, Positronics Part No. DD62F10000
J4	HPN 7025396-52, Positronics Part No. CBC5W5F0000
Mounting	Tray, HPN 7024324-902
TSO markings	C63c, C113

(2) The DU-1080 DU is a large format (8- by 10-inch), 16-color, high resolution flat-panel LCD and symbol generator integrated into a single LRU. The DU presents dynamic displays to the pilot as part of the EDS. The DUs are identical and interchangeable.

(3) A hold-down tray assembly holds the DU in the aircraft instrument panel. Do not block the center cutout in the bottom of the tray. The physical design of the DU requires forced-air circulation for cooling its internal subassemblies. One fan mounted on the top of the DU supplies the forced-air cooling. The fan pulls air into the DU through the ventilation holes in the bottom of the DU, where the air is then directed over the subassemblies.

(4) The DU has nonvolatile maintenance memory that records in-flight faults. The maintenance memory can be read when the DU is in a factory test environment.

(a) Video and Dimming System

1 The auto-dimming system sends a signal to the video system to control the overall display intensity. In the auto-dimming system, a strategically placed ambient light sensor generates a control signal to modulate the pilot-selected display intensity (from the dimming control on the DC-550 display controller).

(b) System Monitor

1 The DU incorporates system monitors that supply a signal to the IC-615 whenever the following conditions are detected:

- Remote image bus (RIB) failure
- LCD heater
- ARINC 429 data failure
- HDLC bus failure
- DU brightness control failure.

C. DC-550 Display Controller

(1) The DC-550 display controller is mounted in the instrument panel next to the pilot's and copilot's PFD. Figure 2-1-3 shows a graphical view of the DC-550 display controller. Table 2-1-4 gives items and specifications particular to the controller.

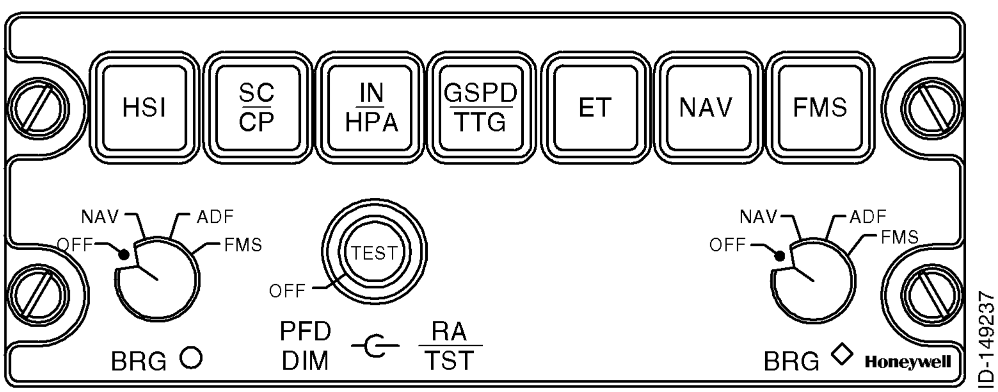

Figure 2-1-3. DC-550 Display Controller

Table 2-1-4. DC-550 Display Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	2.25 in. (57.15 mm)
• Width	5.75 in. (146.05 mm)
• Length	6.87 in. (174.50 mm)
Weight (maximum)	2.0 lb (0.91 kg)
Power requirements:	
• Primary	28 V dc, 5.0 W (max)
• Lighting	5 V ac, 5.0 W (max)
User replaceable parts:	
• Knobs:	
- BRG ○ (setscrew A)	HPN 7009437
- BRG ◇ (setscrew A)	HPN 7009437
- RA (setscrew B)	HPN 7018748-1
- Test button HUB (setscrew B)	HPN 7009644-3
• Setscrews:	
- A (Multispline, 2-56 x 1/8 in., cup point)	HPN 2500148-64
- B (Multispline, 4-40 x 3/16 in., cup point)	HPN 2500148-130
Mating connector J1	MS27473E20-B35SB
Mounting	Standard Dzus Rail

(2) The DC-550 display controller lets the pilot or copilot select the following EDS display functions:

- Bearing pointer
- Groundspeed or time-to-go (TTG) display
- Compass format for weather radar display
- Elapsed time display reset
- Navigation source
- Inches of mercury or hectopascals
- Cross pointers or single cue.

(3) The display controller also supplies a data acquisition function for the following remotely mounted controllers:

- MS-560 mode selector
- RI-553 instrument remote controller
- Remote mounted switches.

(4) Upon receiving signals from a remote controller, the display controller transmits the acquired information to the IC-615 IAC on a two-wire digital interface bus (DC-IC). One bit is assigned on the digital bus for each button and switch input. The IC-615 IAC is configured through software to assign the appropriate function to each bit.

(5) If a display controller is invalid when power is applied to the system after a cold start, the selections in Table 2-1-5 are automatically displayed on the PFD.

Table 2-1-5. PFD Selections With DC-550 Display Controller Invalid

Function	Left Display	Right Display
Compass display format	Full	Full
FD commands	Displayed	Displayed
FD modes	Inhibited	Inhibited
Selected source	NAV 1	NAV 2
GSPD/TTG	GSPD	GSPD

(6) A listing of the display controller functions follows. Each function can have more than one toggling sequence.

(a) HSI Button

1 The pilot or copilot uses the HSI button to change the PFD from a full heading compass format to a partial heading compass format. In the full heading compass mode, 360 degrees of heading is displayed. In the partial heading compass mode, 90 degrees of heading along with weather radar data is displayed if WX is selected using the MC-800 MFD controller. The power-up default for this selection is full heading compass format.

(b) SC/CP Button

1 The pilot or copilot uses the SC/CP button to toggle between single cue or cross pointer flight director command bars. The power-up default is single cue if the cross pointer discrete is open, or if this discrete is grounded, the default is cross pointers.

(c) IN/HPA Button

1 The pilot or copilot uses the IN/HPA button to toggle the barometric (baro) set digital readout on the PFD between inHg and hPa. The power-up default for this selection is dependent on the HPA configuration discrete (open = IN and ground = HPA).

(d) GSPD/TTG Button

1 The pilot or copilot uses the GSPD/TTG button to display groundspeed or time-to-go in the lower right corner of the PFD. The PFD alternates between displaying GSPD or TTG each time the button is pushed. If ET is currently being displayed, pushing the GSPD/TTG button selects whichever parameter was previously displayed. The power-up default for this selection is GSPD.

(e) ET Button

1 The ET button lets the pilot or copilot control an elapsed time (ET) display on the PFD and MFD. Initial switch activation starts the timer sequence at the previous position. Subsequent switch activation follows this toggle sequence:

- Reset
- Elapsed time
- Stop
- Repeat.

(f) NAV Button

1 The pilot or copilot uses the NAV button to select short range navigation sources for display on the PFD. The power-up default for this selection is on-side NAV source. The toggling sequence is as follows:

- First push: onside NAV
- Second push: cross-side NAV
- Repeat.

(g) FMS Button

1 The pilot or copilot uses the FMS button to select long range navigation sources for display on the PFD. The power-up default for this selection is onside FMS source. The toggling sequence is as follows:

- First push: onside FMS
- Second push: cross-side FMS
- Repeat.

(h) Bearing (BRG) Source Select Knobs

1 The HSI portion of the PFD can display two independent bearing pointers; BRG ○ or BRG ◇. Bearing source BRG ○ is dedicated to the sources on the left side of the cockpit, and BRG ◇ is dedicated to sources on the right side. The bearing sources given in Table 2-1-6 can be selected for each pointer.

Table 2-1-6. Bearing Sources

BRG ○	**BRG ◇**
OFF	OFF
NAV	NAV
ADF	ADF
FMS	FMS

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2 If the display controller is invalid, the onside NAV bearing is displayed by default.

(i) Radio Altitude (RA) Set Knob

1 The radio altitude control consists of a knob with a button in the center. The pilot or copilot turns the knob to adjust the RA minimums setting, shown as an RA digital readout on the PFD.

(j) PFD DIM Knob

1 The dimming function is controlled by the outer knob of the RA knob and TEST button. The PFD is dimmed as the knob is turned counterclockwise. If the knob is set to the OFF position, the PFD goes blank and the display information is transferred to the MFD.

(k) System TEST Button

1 The RA set knob has a momentary action TEST button. The pilot or copilot pushes and holds the TEST button for 5 to 6 seconds while the aircraft is on the ground (weight on wheels [WOW]) to initiate the test mode, and to do a check of the radio altimeter.

2 The pilot or copilot pushes the TEST button while the aircraft is in the air (weight off wheels) to do a check of the radio altimeter only.

3 The radio altimeter test is functional only if the radio altimeter is connected to the IC-615 IAC test output. If connected, the radio altimeter test can be initiated at any time except during glideslope capture or glideslope track.

4 If the aircraft is on the ground and the TEST button is held for more than 5 to 6 seconds, the system enters the initiated test mode.

5 The following test displays are shown on the PFD and MFD as long as the TEST button is pushed with WOW:

- The course select, heading select, distance, and GSPD/TTG digital displays are replaced by amber dashes.
- The ATT and heading (HDG) displays are flagged.
- All pointers/scales are flagged.
- All heading related bugs/pointers are removed.
- The flight director command bars go out of view.
- The radio altimeter digital readout displays the radio altimeter self-test value.
- The comparator monitor annunciates ATT, HDG, and ILS (if ILS sources are selected on both sides).
- The word TEST (in magenta) is annunciated in the lateral capture location on the top left of the PFD.
- The flight director mode annunciators are removed.
- The radio altitude (comparison monitor) is shown.

D. RI-553 Remote Instrument Controller

(1) The RI-553 remote instrument controller is mounted in the bottom of the pedestal. Figure 2-1-4 shows a graphical view of the RI-553 remote instrument controller. Table 2-1-7 gives items and specifications particular to the controller.

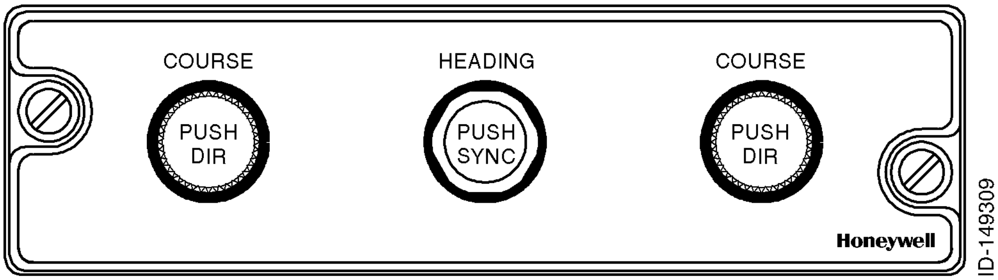

Figure 2-1-4. RI-553 Remote Instrument Controller

Table 2-1-7. RI-553 Remote Instrument Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.50 in. (38.10 mm)
• Width	5.75 in. (146.05 mm)
• Length	1.01 in. (25.65 mm)
Weight (maximum)	0.80 lb (0.36 kg)
Power requirements:	
• Panel lighting	5 V dc, 21.2 W (max)
User replaceable parts:	
• Knobs:	
- COURSE (setscrew A)	HPN 7009644-1
- HEADING (setscrew A)	HPN 7009681-1
- COURSE PUSH DIR (setscrew B)	HPN 7015342-16
- HEADING PUSH SYNC (setscrew B)	HPN 7015342-7
• Setscrews:	
- A (multispline, 4-40 x 1/8 in., cup point)	HPN 2500148-128
- B (multispline, 2-56 x 1/8 in., cup point)	HPN 2500148-64
Mating connector J1	MS27473E14A-35SC
Mounting	Standard Dzus rail

(2) The RI-553 remote instrument controller lets the pilot select HEADING and COURSE references. The front panel has a single HEADING knob and two COURSE knobs. The knobs are connected to rotary switches that have 16 positions and give a quadrature greycode output.

(3) The paragraphs that follow describe the functions of each knob and button.

(a) Left COURSE Knob

1 The left COURSE knob is a rotary knob that controls the course select readout on the pilot's PFD. The knob output of selected course is also sent to the flight director and autopilot for the VOR mode. Clockwise (CW) knob rotation changes the selected course in one-degree increments. Counterclockwise (CCW) knob rotation changes the selected course in one-degree decrements. The knob signal is sent to the DC-550 display controller, which supplies a greycode signal on the DC-IC interface bus to the IC-615 IAC for processing.

2 The COURSE knob contains an integral button that is used to synchronize course. Pushing the PUSH DIR button synchronizes the course readout on the pilot's PFD to the aircraft's direct-to-course, when VOR is the selected navigation source.

(b) Heading Knob

1 The HEADING knob is a rotary knob that controls the heading select digital readout and the heading select bug on both PFDs. The knob output of selected heading is also sent to the flight director/autopilot for turn direction. CW knob rotation changes the selected heading in one-degree increments. CCW knob rotation changes the selected heading in one-degree decrements. The knob signal is sent to the DC-550 display controller, which supplies a greycode signal on the DC-IC interface bus to the IC-615 IAC for processing.

2 The HEADING knob contains an integral button that is used to synchronize heading. Pushing the PUSH SYNC button synchronizes the heading select digital readout and heading select bug to the current aircraft heading.

(c) Right COURSE Knob

1 The right COURSE knob is a rotary knob that controls the course select readout on the copilot's PFD. The knob output of selected course is also sent to the flight director and autopilot for the VOR mode. CW knob rotation changes the selected course in 1-degree increments. CCW knob rotation changes the selected course in 1-degree decrements. The knob signal is sent to the DC-550 display controller, which supplies a greycode signal on the DC-IC interface bus to the IC-615 IAC for processing.

2 The COURSE knob contains an integral button that is used to synchronize course. Pushing the PUSH DIR button synchronizes the course select digital readout on the copilot's PFD to the aircraft's direct-to-course, when VOR is the selected NAV source.

E. RI-552 Remote Instrument Controller

(1) The RI-552 remote instrument controller is mounted in the bottom of the pedestal. The RI-552 remote instrument controller lets the copilot select symbol generator reversion (SG REV) and altitude preselect (ALT SEL). The front panel has a single ALT SEL knob and a single SG REV knob. Selections are routed to the DC-550 display controllers, and from there to both IC-615 IACs. Figure 2-1-5 shows a graphical view of the RI-552 remote instrument controller. Table 2-1-8 gives items and specifications particular to the controller.

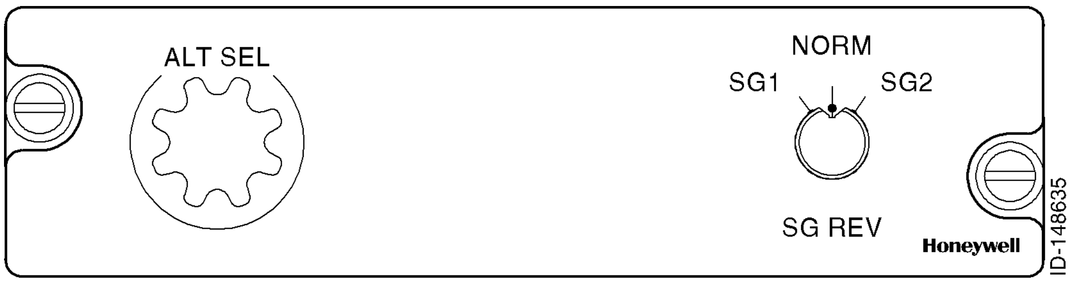

Figure 2-1-5. RI-552 Remote Instrument Controller

Table 2-1-8. RI-552 Remote Instrument Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.50 in. (38.10 mm)
• Width	5.75 in. (146.05 mm)
• Length	1.01 in. (25.65 mm)
Weight (maximum)	0.80 lb (0.36 kg)
Power requirements:	
• Panel lighting	5 V dc, 21.2 W (max)
User replaceable parts:	
• Knobs:	
- ALT SEL	HPN 7019971
- SG REV	HPN 7011875-902
• Setscrew:	
- Multispline, 2-56 x 1/8 in., cup point	HPN 2500148-64
Mating connector J1	MS27473E14A-35SC
Mounting	Standard Dzus rail

F. MC-800 MFD Controller

(1) The MC-800 MFD controller is mounted in the top of the pedestal. Figure 2-1-6 and Figure 2-1-7 show a graphical view of the MC-800 MFD controller. Table 2-1-9 gives items and specifications particular to the controller.

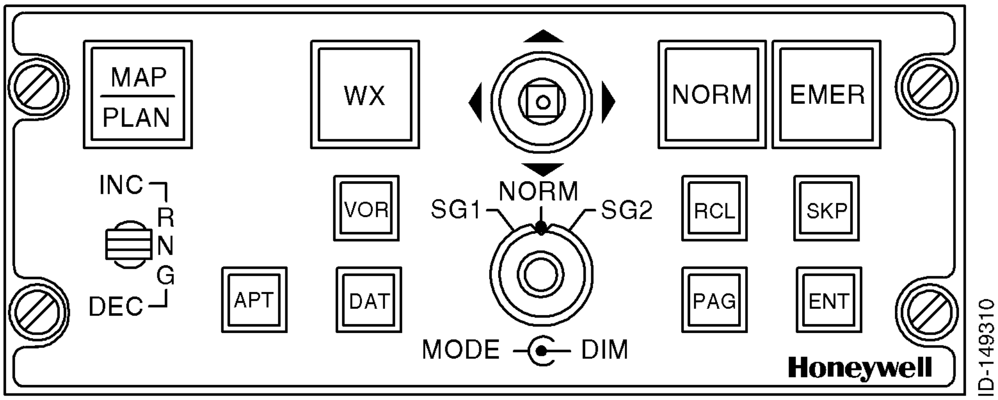

Figure 2-1-6. MC-800 MFD Controller Without TCAS

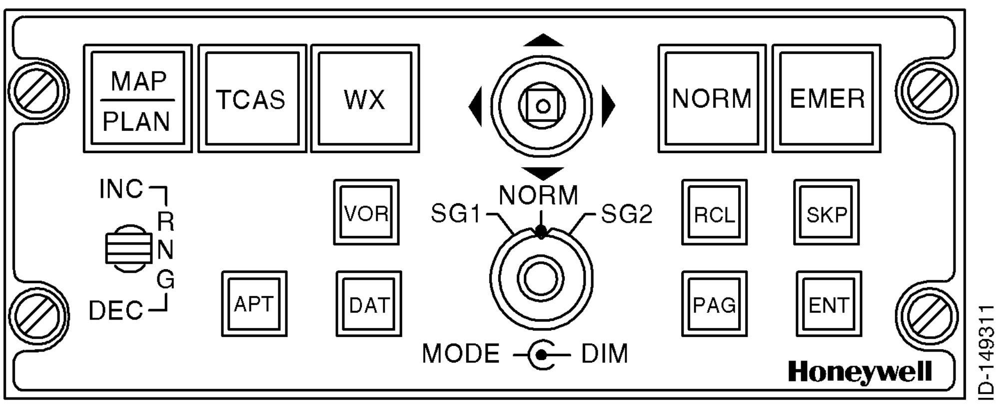

Figure 2-1-7. MC-800 MFD Controller With TCAS

Table 2-1-9. MC-800 MFD Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	2.25 in. (57.15 mm)
• Width	5.75 in. (146.05 mm)
• Length	6.59 in. (167.38 mm)
Weight (maximum)	1.8 lb (0.82 kg)
Power requirements:	
• Primary	28 V dc, 5.0 W (max)
• Lighting	5 V dc, 5.0 W (max)
User replaceable parts:	
• Knobs:	
- MODE	HPN 7008180
- DIM	HPN 7008181
• Setscrew (Multispline, 2-56 x 1/8 in., cup point)	HPN 2500148-64
Mating connector J1	MS27473E14-35S
Mounting	Standard Dzus rail

(2) The MC-800 MFD controller lets the pilot or copilot select display formats and modes that change the information on the MFD. This includes display dimming, map or plan and weather displays, normal and emergency checklists, and optional TCAS resolution and traffic advisories. The controller also lets the pilot select the display backup mode. The paragraphs that follow describe the available functions.

(a) Display Select Buttons

1 MAP/PLAN Button

a The MAP/PLAN button alternately selects the heading up map mode or the north up plan mode for display.

2 TCAS Button

a The TCAS button is an optional button that selects the fixed range traffic advisory display function.

3 Weather (WX) Button

a The WX button is used to call up weather radar returns on the MFD map display. When weather is displayed, the map range is controlled by the WC-880 radar controller.

4 Normal (NORM) Button

a The NORM button gives entry into the normal checklist display function. The normal checklist is arranged in the order of standard flight operations. Pushing the button causes presentation of the normal checklist index page that contains the lowest order incomplete and unskipped checklist with the active selection at that checklist. The SKP, RCL, PAG, and ENT buttons and the joystick control this function.

5 Emergency (EMER) Button

a The EMER button gives entry into the emergency checklist display function. Pushing the EMER button results in the presentation of the first page of the highest priority callup with the active selection at the first item on the page. The SKP, RCL, PAG, and ENT buttons and the joystick control this function.

(b) Checklist Control

1 Skip (SKP) Button

a Pushing the SKP button skips the active selection to the next item. If the item skipped is the last item, the active selection is the lowest order skipped item.

2 Recall (RCL) Button

a Pushing the RCL button results in presentation of the page containing the lowest order skipped item with the active selection at that item.

3 Page (PAG) Button

a Pushing the PAG button advances the page count. The active selection is the lowest order incomplete item on that page. If there are no incomplete items on the page, the active selection is the first item on the page.

4 Enter (ENT) Button

a Operation of the ENT button depends upon whether the display is an index page or a checklist page. If the ENT button is pushed when on an index page, a checklist corresponding to the active index line selection is displayed. The checklist is presented at the page containing the lowest order incomplete item with the active selection at that item. If the checklist had previously been completed, the system forces all items in the checklist to incomplete and presents the first page of the checklist with the active selection at the first item.

b If the ENT button is pushed when on a checklist page, activation forces the active selection to complete and advance the active selection to the next incomplete item. If ENT is activated with the active selection at the last item in a checklist, the operation depends upon the completion status of the checklist.

c If the checklist is not complete (one or more items skipped), the system presents the page containing the lowest order incomplete item with the active selection at that item.

d If the checklist is complete (all items complete), the system presents the index page containing the next higher order checklist with the active selection at that checklist.

5 Joystick

a The joystick gives additional paging and cursor control. Each activation results in the action described:

- UP moves the active selection to the lower order item.
- DOWN moves the active selection to the next higher order item (this is identical to SKP).
- LEFT results in presentation of the previous page.
- RIGHT results in presentation of the next page (this is identical to PAG).

(c) Designator Control (FMS Only)

1 Skip (SKP) Button

a Pushing the SKP button skips the designator's home position to the next displayed waypoint. When activated with the designator at the last displayed waypoint, the designator returns to present position.

2 Recall (RCL) Button

a When the designator is not at its home position, activation of RCL recalls the designator to the home position. Activation with the designator at its home position recalls the designator to present position, if not already there.

3 Enter (ENT) Button

a When the designator is offset, activation of ENT causes the LAT/LON of the designator to be transmitted to the selected LRN as a requested waypoint.

4 Joystick

a The joystick gives four-direction control of the designator: up, down, left, and right. The course and distance to the designator from its home position is displayed in the lower right corner of the display.

(d) VOR Button

1 The VOR button is used to add or remove VOR/DME symbols to the map and plan displays.

(e) Data (DAT) Button

1 The DAT button is used to add or remove LRN information to the map and plan displays.

(f) Airport (APT) Button

1 The APT button adds or removes airport designators to the map and plan displays.

(g) Increase (INC)/Decrease (DEC) Range (RNG) Switch

1 This switch increases or decreases the map or plan range (5, 10, 25, 50, 100, 200, 300, 600, and 1200 NM) if the WX mode is not selected. When WX is selected, the range is controlled by the WC-880 weather radar controller.

(h) MODE/DIM Control

1 The MODE/DIM set control has two concentric knobs. The outer knob selects MFD modes of operation. The inner knob adjusts the intensity of the MFD.

2 MODE Selector

a This knob is a three-position rotary knob that selects the following MFD modes of operation:

- NORM. The NORM position selects normal MFD operation.
- SG1. The SG1 position lets the IC-615 IAC No. 1 drive all displays.
- SG2. The SG2 position lets the IC-615 IAC No. 2 drive all displays.

3 DIM Control

a This knob controls overall MFD dimming.

3. Operation

A. EDS Bus Interfaces

(1) Display data is carried by several multiuser, serial asynchronous, half-duplex, digital communication buses. These display/data buses include the following:

- A digital display bus output from each IC-615 IAC to each DU
- Display controller to IC-615 IAC (DC-IC) buses
- DU wraparound buses to each IC-615 IAC
- One MFD control bus to the IC-615 IAC (MC-IC)
- Left and right weather radar control (WC) and picture buses
- One IC-615 IAC to IC-615 IAC (IC-IC) data bus.

(2) These display data buses are the primary communication paths between the IC-615 IACs, DU-1080 DUs, and the controllers. All of these buses are made up of RS-422 transmitters and receivers connected by shielded twisted wire pairs. Data is encoded in either two's complement fractional binary notation or binary coded decimal notation, and transmitted by a single transmitter to either a single receiver or to a group of receivers connected in parallel.

(3) All of the buses, except the IC-IC bus, carry data in one direction only. They use separate receivers, transmitters, and twisted wire pairs. The IC-IC bus is bidirectional. This bus uses very large scale integration (VLSI) Manchester encoder/decoder chips with buffered inputs and outputs to transmit and receive data on the same twisted wire pair. Data transmitted onto any bus drives one line more positive and the other line more negative.

(4) Control and data protocols are predefined. Each bus works on a message basis without bus controllers commanding users to transmit data and without frame controls or transmit requests. Data broadcasts follow the HDLC message format as described in ISO 3309–1979 (E). Since each user knows its own user number, the bus user sets up an internal timer, based upon the last message received, and transmits at the appropriate time.

(a) Digital Display Bus

1 Each IC-615 IAC has a dedicated 1-MHz display bus output. This bus, as shown in Figure 2-1-8, lets the DUs receive display format information. The DU can receive display formats from four sources and weather radar data from three sources.

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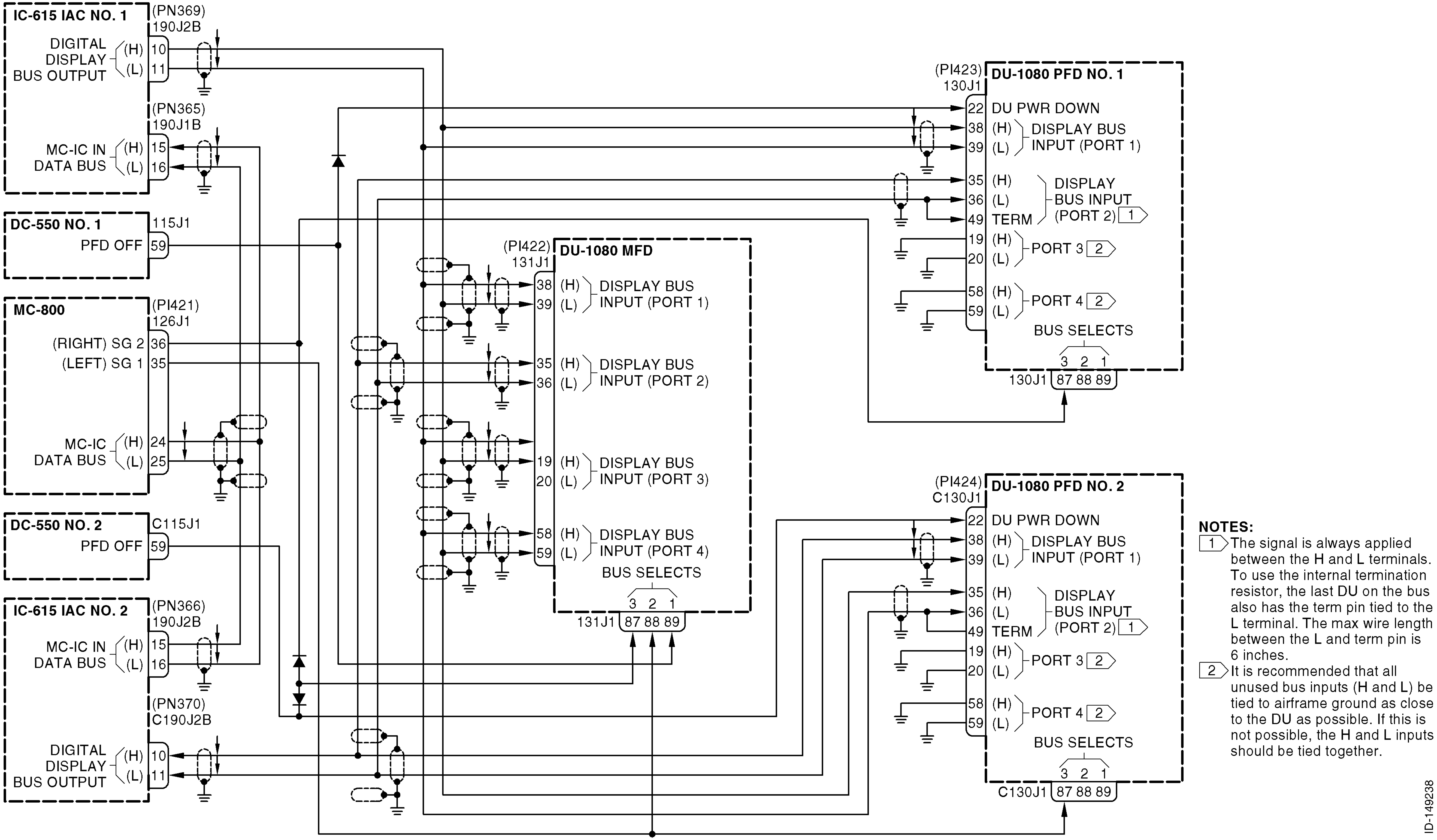

NOTES:

1. The signal is always applied between the H and L terminals. To use the internal termination resistor, the last DU on the bus also has the term pin tied to the L terminal. The max wire length between the L and term pin is 6 inches.
2. It is recommended that all unused bus inputs (H and L) be tied to airframe ground as close to the DU as possible. If this is not possible, the H and L inputs should be tied together.

Figure 2-1-8. Display Bus Interface

(b) DC-IC Data Bus

1 The DC-550 display controller uses a DC-IC bus running at 9600 baud rate to transmit data to the IC-615 IAC. This bus, as shown in Figure 2-1-9, transmits momentary switch inputs and ground/open discretes (2-wire quadrature knob rotation data) to the IC-615 IAC from the controllers and remote switches listed as follows:

- DC-550 display controller
- MS-560 mode selector
- RI-553 remote instrument controller
- Attitude and heading reversion switches.

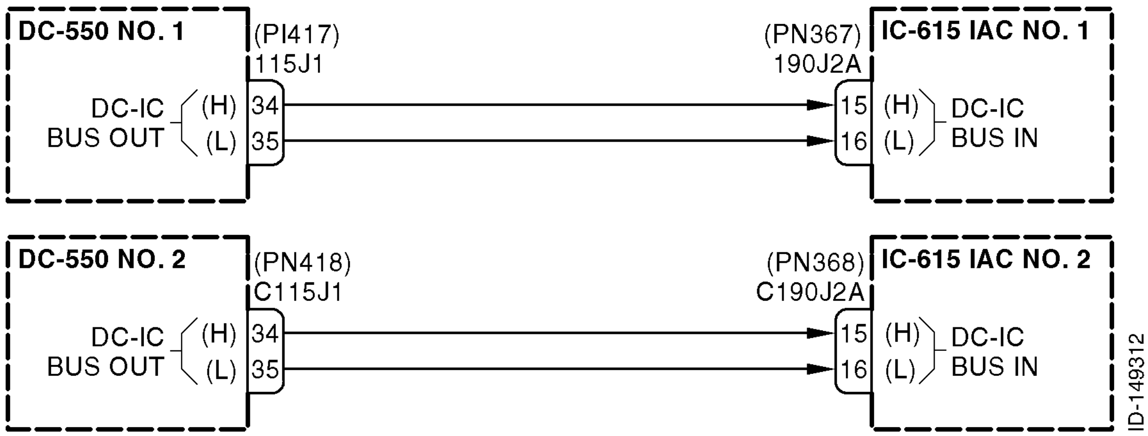

Figure 2-1-9. DC-IC Data Bus

(c) DU-1080 Wraparound Bus

1 Each IC-615 IAC receives data from the DU-1080 over a 1-MHz bus. This bus, as shown in Figure 2-1-10, contains status information broadcast from the DU-1080 and any requested wraparound data (pitch, roll, altitude, and indicated airspeed). Under DU reversion conditions (assuming no IC reversion), the IC-615 IAC looks at another DU bus for the wraparound information.

2 The DU wraparound logic is based on the following installation:

- No. 1 IC-615 IAC:
  - DU wraparound port 1 connected to left DU.
  - DU wraparound port 2 connected to center DU.
  - DU wraparound port 3 not connected.
- No. 2 IC-615 IAC:
  - DU wraparound port 1 connected to right DU.
  - DU wraparound port 2 not connected.
  - DU wraparound port 3 connected to center DU.

NOTE: Center DU cannot be turned OFF.

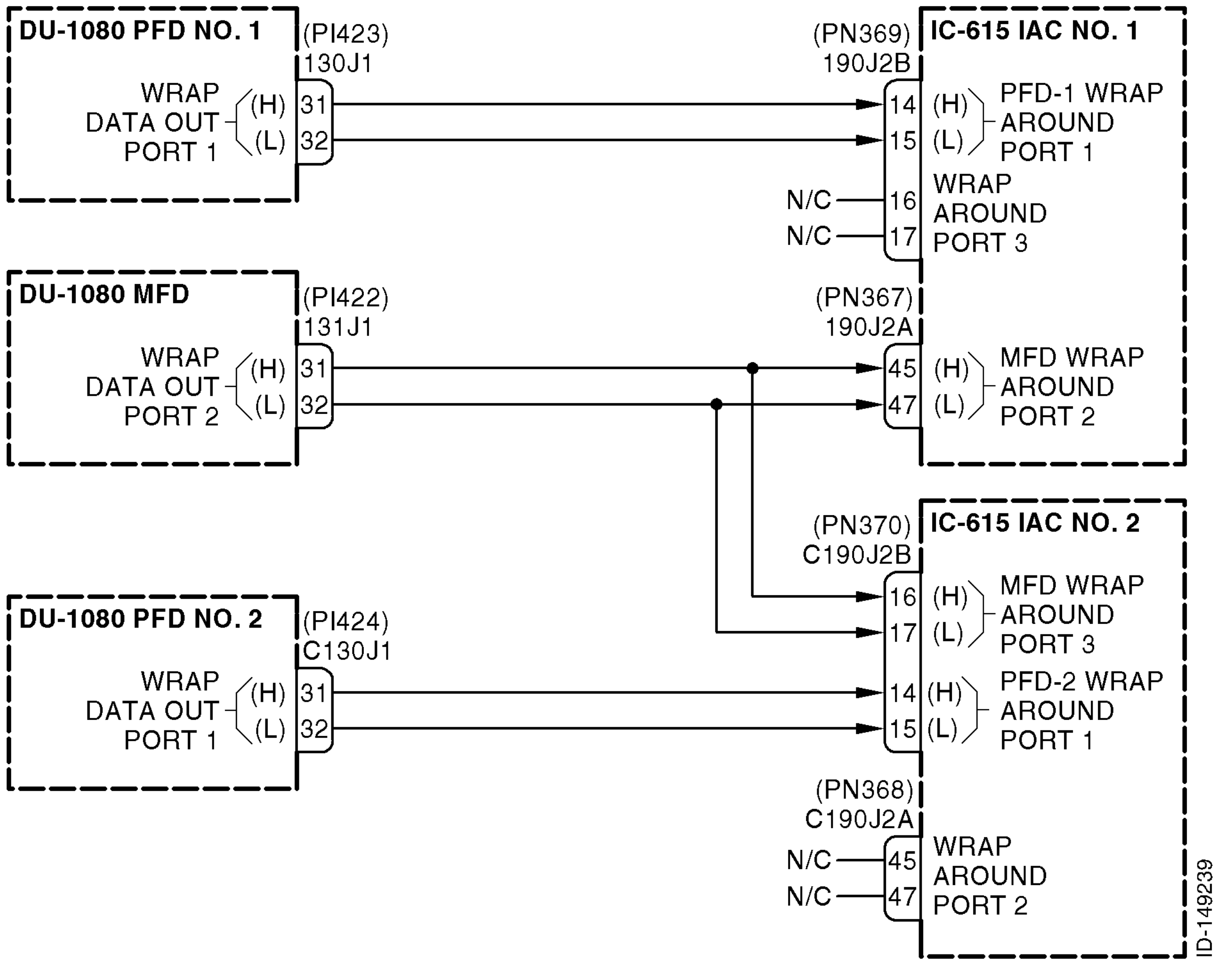

Figure 2-1-10. DU Status and Wraparound

(d) IC-615 IAC Reversionary Control

1 The display controllers and the MFD controller together generate the reversionary modes of the PRIMUS 1000 system. Based on the MC-800 and the DC-550 switch positions given in Table 2-1-10, the IC-615 IAC drives the format on the indicated DUs. See Figure 2-1-11 for the hardware interconnect that supports reversionary control.

Table 2-1-10. Reversionary Control

MC-800 Rotary Knob Position	DC-550 No. 1 PDF Dim Knob Position	DC-550 No. 2 PFD Dim Knob Position	DU-1080 No. 1					DU-1080 (MFD)					DU-1080 No. 2				
			Bus Select			Port No.	Display Format	Bus Select			Port No.	Display Format	Bus Select			Port No.	Display Format
			3	2	1			3	2	1			3	2	1		
NORM	ON	ON	o	o	o	1	PFD1	o	o	o	1	MFD1	o	o	o	1	PFD2
SG1	ON	ON	o	o	o	1	PFD1	o	g	o	3	MFD1	g	o	o	2	PFD1
SG2	ON	ON	g	o	o	2	PFD2	g	o	o	2	MFD2	o	o	o	1	PFD2
NORM	OFF	ON	N/A			N/A	NONE	o	o	g	1	PFD1	o	o	o	1	PFD2
NORM	ON	OFF	o	o	o	1	PFD1	g	o	o	2	PFD2	N/A			N/A	NONE
NORM	OFF	OFF	N/A			N/A	NONE	g	o	g	2	PFD2	N/A			N/A	NONE
SG1	OFF	ON	N/A			N/A	NONE	o	g	g	1	PFD1	g	o	o	2	PFD1
SG1	ON	OFF	o	o	o	1	PFD1	g	g	o	4	PFD1	N/A			N/A	NONE
SG1	OFF	OFF	N/A			N/A	NONE	g	g	g	4	PFD1	N/A			N/A	NONE
SG2	OFF	ON	N/A			N/A	NONE	g	o	g	2	PFD2	o	o	o	1	PFD2
SG2	ON	OFF	g	o	o	2	PFD2	g	o	o	2	PFD2	N/A			N/A	NONE
SG2	OFF	OFF	N/A			N/A	NONE	g	o	g	2	PFD2	N/A			N/A	NONE

NOTES:

1. SG1 indicates IC-615 IAC No.1 driving all active DUs.
2. SG2 indicates IC-615 IAC No.2 driving all active DUs.
3. MFD1 or PFD1 indicates display format driven by IC-615 IAC No.1.
4. MFD2 or PFD2 indicates display format driven by IC-615 IAC No.2.
5. g = Indicates DU bus select is GROUND.
6. o = Indicates DU bus select is OPEN.

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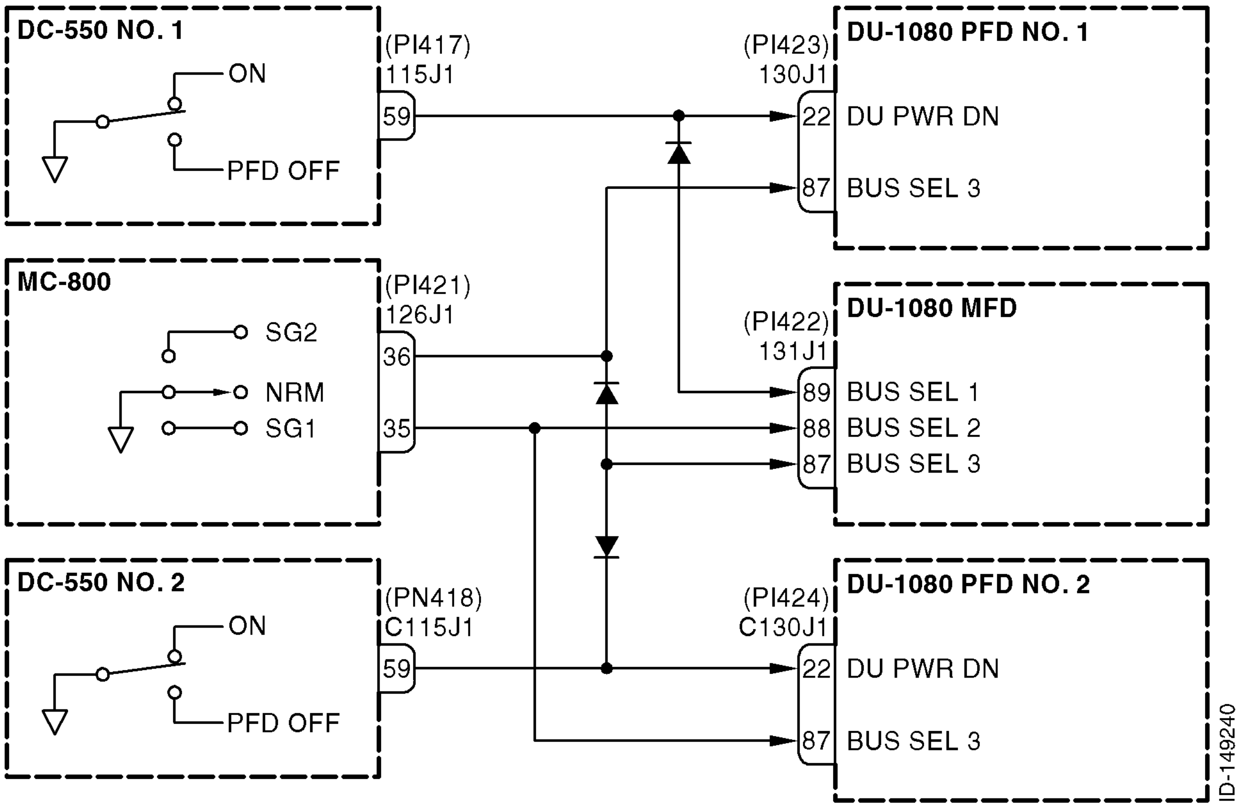

Figure 2-1-11. Reversionary Interconnect

(e) MC-IC Data Bus

1 The MC-800 MFD controller uses a single RS-422 data bus (MC-IC) to continuously transmit data to both IC-615 IACs. The data format consists of one start bit, eight data bits, an odd parity, and one stop bit. Mode codes (NORM, SG1, SG2) are always included with the data. Joystick codes are also sent as long as the joystick is in an operating position. Button closures are only sent twice, then a none code is sent until the next button is pushed.

(f) Weather Radar Control and Picture Buses

1 The weather radar interface is made up of a picture bus and a control bus, as shown in Figure 2-1-12. The picture bus interfaces directly with the PFD and MFD, and the control bus interfaces with the IC-615 IAC. The picture bus is used to transmit partially scan-converted weather radar video directly to the DU-1080 display unit. The control bus is used to transmit radar status information to the IC-615 IAC. Mode annunciations are received over the serial interface from the WU-880 RTA.

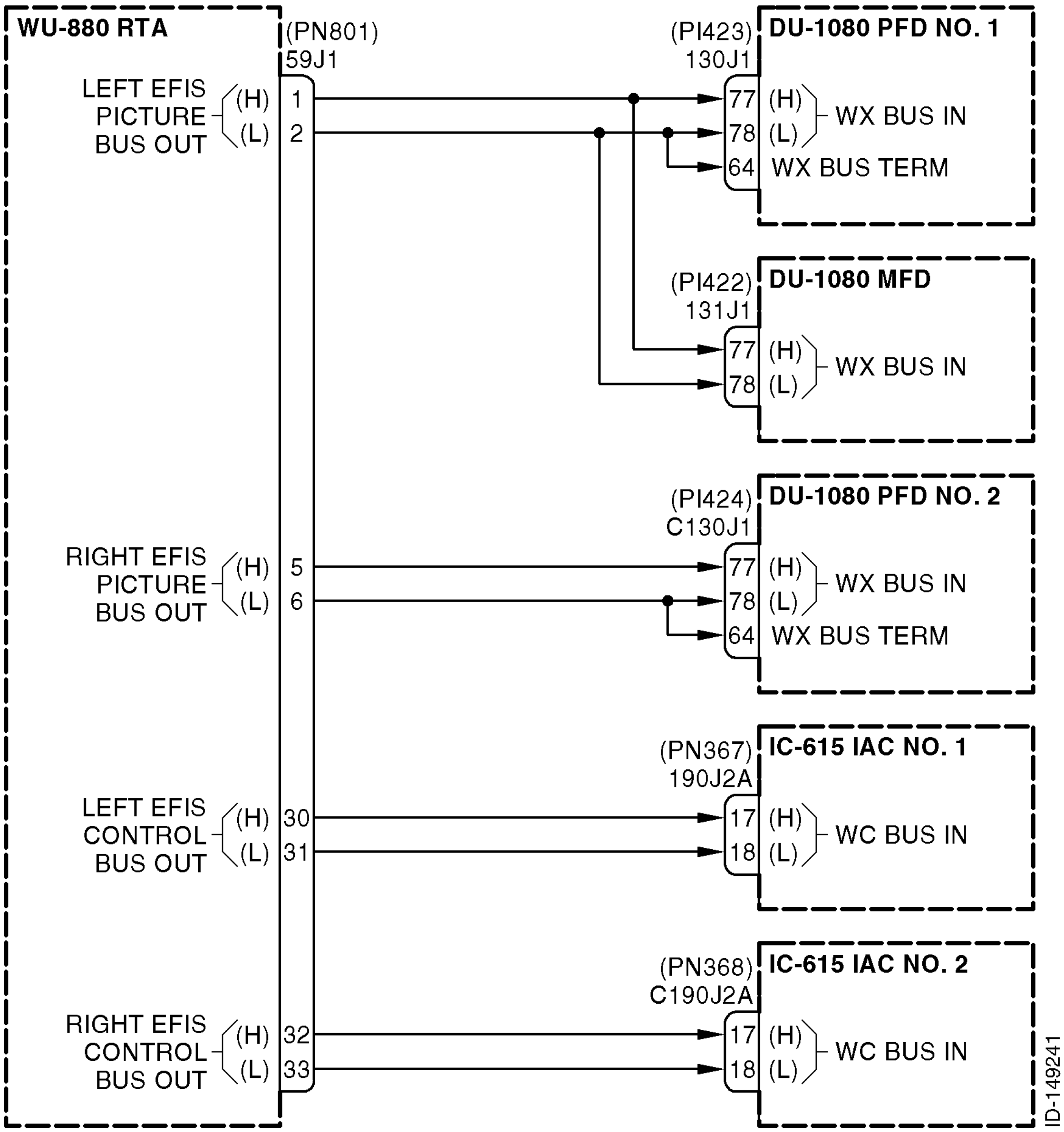

Figure 2-1-12. Weather Radar Control and Picture Buses

2 Weather radar returns can be displayed on the PFD when the weather radar format is selected by the DC-550 display controller and on the MFD when WX is selected from the MC-800 MFD controller. The WC-880 controller interfaces with the WU-880 RTA through a low-speed serial bus and outputs the different WX modes selected. The WU-880 echoes this information to the IC-615 IAC.

3 Data representing knob and switch selections are encoded in either two's complement fractional binary notation or binary coded decimal notation and transmitted to the WU-880 RTA. The bus is connected by a shielded twisted wire pair that carries data in one direction only.

4 Serial bus transmissions are words made up of three bytes of serial information. The first byte is called the (octal) label, which identifies the type of data contained within the word, and the second and third bytes are the data.

(g) IC-IC Bus

1 The IC-615 IAC uses a high-speed data bus for communication with the cross-side IC, as shown in Figure 2-1-13. This data bus supplies the means to perform the following tasks:

- Communicate between the left and right IC-615 IAC
- Load software in the IC-615 IAC
- Record internal parameters
- Modify gains in the IC-615 IAC during flight test.

2 The IC-615 IAC to IC-615 IAC or cross-side message is made up of a block of 260 16-bit words. Data flow on the IC bus is bidirectional (two-way transmit and receive). The first IC-615 IAC to go online at power-up initializes the IC-IC bus for communication by transmitting a power-up data message. When an IC-615 IAC has established system communication, the other bus users listen and then synchronize their data messages with the last message received on the bus.

3 Bus contention between users is avoided through the use of a delayed power-up scheme. Power-up priority is based on the users' identification pins. Table 2-1-11 lists assigned user priority and delay sequence. When power is first applied, a timer in IC-615 IAC No. 1 is initialized for the delay specified in Table 2-1-11. At the same time, a receiver in the same IC-615 IAC is enabled and begins polling the bus for valid transmissions.

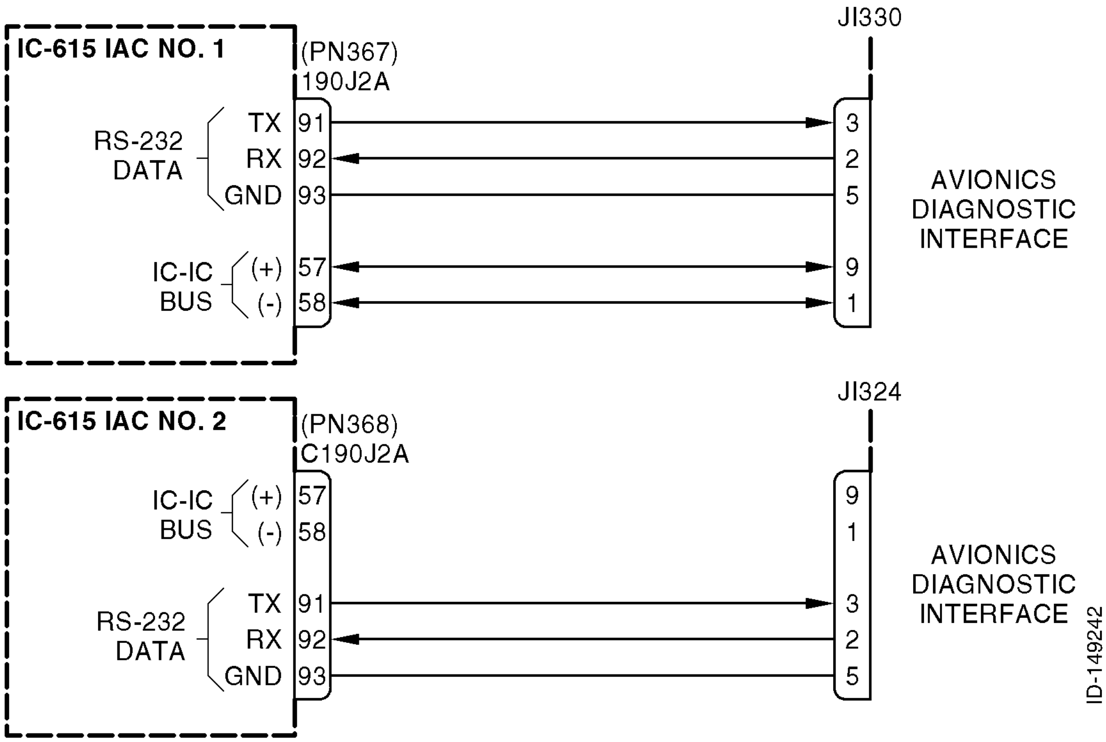

Figure 2-1-13. IC-IC Bus/RS-232 Cabin Interface

Table 2-1-11. Power-Up Priority Assignment

Identification Pins	Priority	Power-up Delay
IC-615 IAC No. 1	1	45 ms
IC-615 IAC No. 2	2	55 ms

4 If the IC-615 IAC No. 1 recognizes that another user is on the bus, it goes into synchronized processing. If no data is found on the bus before the timer expires, the IC-615 IAC enables a transmitter, resets the power-up timer, and listens for bus activity. If no data is found before the timer again expires, the IC-615 IAC No. 1 transmits power-up data onto the bus.

5 After the transmission has been completed, the IC-615 IAC restarts the search for additional data. This power-up sequence is repeated by the IC-615 IAC No. 2, with the delay specified in Table 2-1-11.

B. AHRS Interface

(1) The Litton LCR-93 (AHRS) supplies ARINC 429 data to the IACs. Either IC-615 IAC displays the cross-side attitude source. The pilot's AHRS interface is shown in Figure 2-1-14. The copilot's interface is shown in Figure 2-1-15.

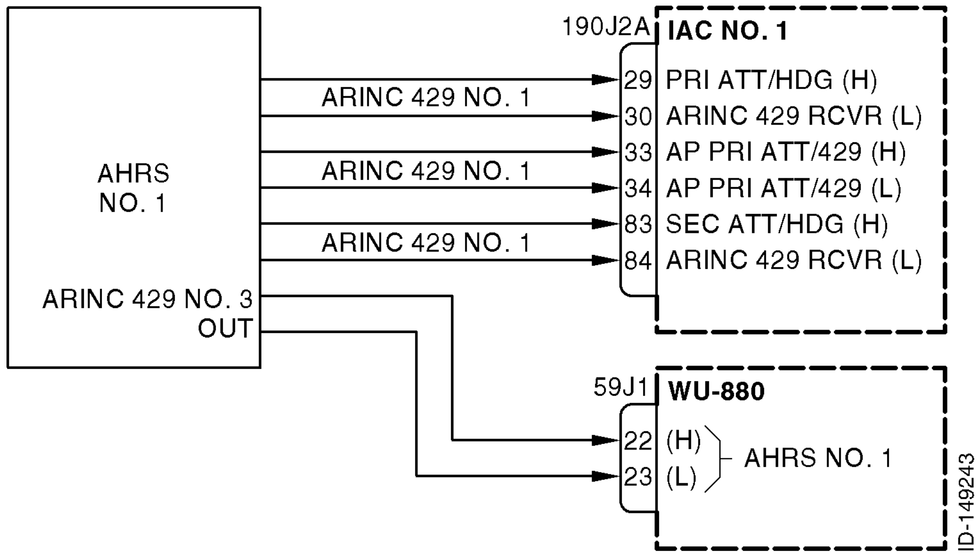

Figure 2-1-14. AHRS (Pilot) Interface

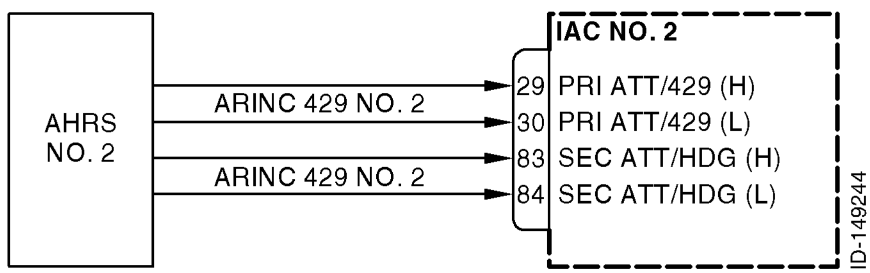

Figure 2-1-15. AHRS (Copilot) Interface

(a) Radio Interface

1 The IC-615 IAC radio interface uses the Honeywell RSB. The RSB is a 2/3 MHz bus that operates on the HDLC hardware interface. Two of the three buses that make up the RSB are connected to the IC-615 IACs. The left secondary bus carries messages 0, 3, 6, 9, 12, 15, and 18. The right secondary bus carries messages 1, 4, 7, 10, 13, 16, and 19. The primary bus carries a composite of the messages contained within the left and right secondary buses. The left (pilot's) IC-615 uses the left secondary bus as its primary source. The right (copilot's) IC-615 uses the right secondary bus as its primary source. Both IC-615 IACs listen to the to the primary bus for the secondary source. The IACs receive all input data from the RSB, but use only the NAV messages for short range navigation (SRN). Messages transmitted on the RSB are separated by 8.0-ms intervals. Nominally, each message is transmitted in 800 microseconds. The IACs support either a single or dual DME installation. Table 2-1-12 defines the RSB interface, and Table 2-1-13 gives the DME data from dual and single DME systems.

Table 2-1-12. Radio System Bus Interface

RSB Message	Word Sequence Position (WSP)	Input Data Description
0, 12	10, 11	Left DME distance
0	12	Left DME hold
0	14	Left DME groundspeed
0	15	Left DME time to station (TTG)
0	19	Left VOR/ILS frequency
Refer to Table 2-1-13	Refer to Table 2-1-13	Right DME distance
Refer to Table 2-1-13	Refer to Table 2-1-13	Right DME hold
Refer to Table 2-1-13	Refer to Table 2-1-13	Right DME groundspeed
Refer to Table 2-1-13	Refer to Table 2-1-13	Right DME time to station (TTG)
1	19	Right VOR/ILS frequency
6, 18	2	Left ADF bearing (case referenced)
6, 18	4	Left VOR bearing (if not tuned to localizer [TTL])
---	---	Left localizer deviation (if TTL)
6, 18	5	Left glideslope deviation (includes TTL)
6, 18	6	Left marker beacons
6	23	Left ADF frequency
7, 19	2	Right ADF bearing (case referenced)
7, 19	4	Right VOR bearing (if not TTL)

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Table 2-1-12. Radio System Bus Interface (cont)

RSB Message	Word Sequence Position (WSP)	Input Data Description
---	---	Right localizer deviation (if TTL)
7, 19	5	Right glideslope deviation (includes TTL)
7, 19	6	Right marker beacons
7	23	Right ADF frequency
9	2	Left VHF COM status
9	3	Left VHF COM frequency
9	7	Left radio mode (IDENT)
9	8	Left beacon transponder code
10	2	Right VHF COM status
10	3	Right VHF COM frequency
10	7	Right radio mode (IDENT)
10	8	Right beacon transponder code

Table 2-1-13. DME Data from Dual and Single DME Systems

NAV Message	Source	DME Distance	Groundspeed	Time to Station	DME Frequency
		Dual DME Systems			
0	Primary	WSP 10, 11	WSP 14	WSP 15	WSP 13
1	Secondary	WSP 6, 7	None	None	None
12	Primary	WSP 10, 11	None	None	None
13	Secondary	WSP 6, 7	WSP 14	WSP 15	WSP 13
		Single DME Systems			
0	Primary	WSP 10, 11	WSP 14	WSP 15	WSP 13
0	Secondary	WSP 6, 7	None	None	None
12	Primary	WSP 10, 11	None	None	None
12	Secondary	WSP 6, 7	WSP 14	WSP 15	WSP 13

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2 Short Range NAV (VOR/LOC/GS/ADF/DME)

a Short range NAV data is supplied through the primary and secondary radio system buses (Figure 2-1-16). The NAV receiver supplies radio deviation, to/from, bearing, and flag outputs to the IC-615 IAC for two purposes: primary flight display, and automatic tracking and capture of the selected navigation source.

b Localizer data is used to provide lateral guidance to the aircraft for alignment with the centerline of the runway. Localizer deviation is displayed on the PFD. The flight guidance function of the IC-615 IAC also uses localizer deviation for automatic capture and tracking of the localizer beam.

c Glideslope data is used to provide vertical guidance to the aircraft to enable a linear descent to the runway threshold. Glideslope deviation is displayed on the PFD. The flight guidance function of the IC-615 IAC also uses glideslope deviation for automatic capture and tracking of the glideslope beam.

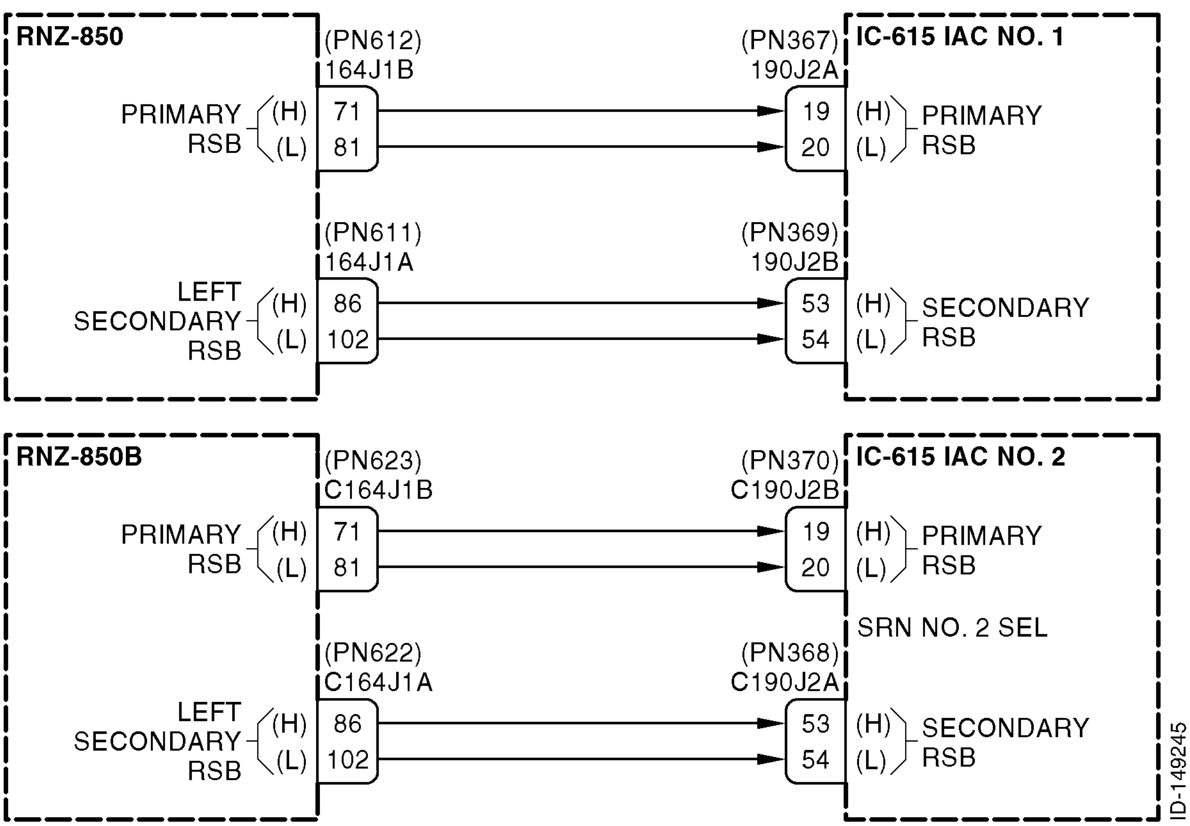

Figure 2-1-16. Navigation Receiver to IC-615 IAC Interface

3 DME Indicator

a The DME indicator interface (Figure 2-1-17) into the IC-615 IAC is through the primary and secondary radio system buses. TTG, groundspeed, and slant range distance are displayed on the PFD.

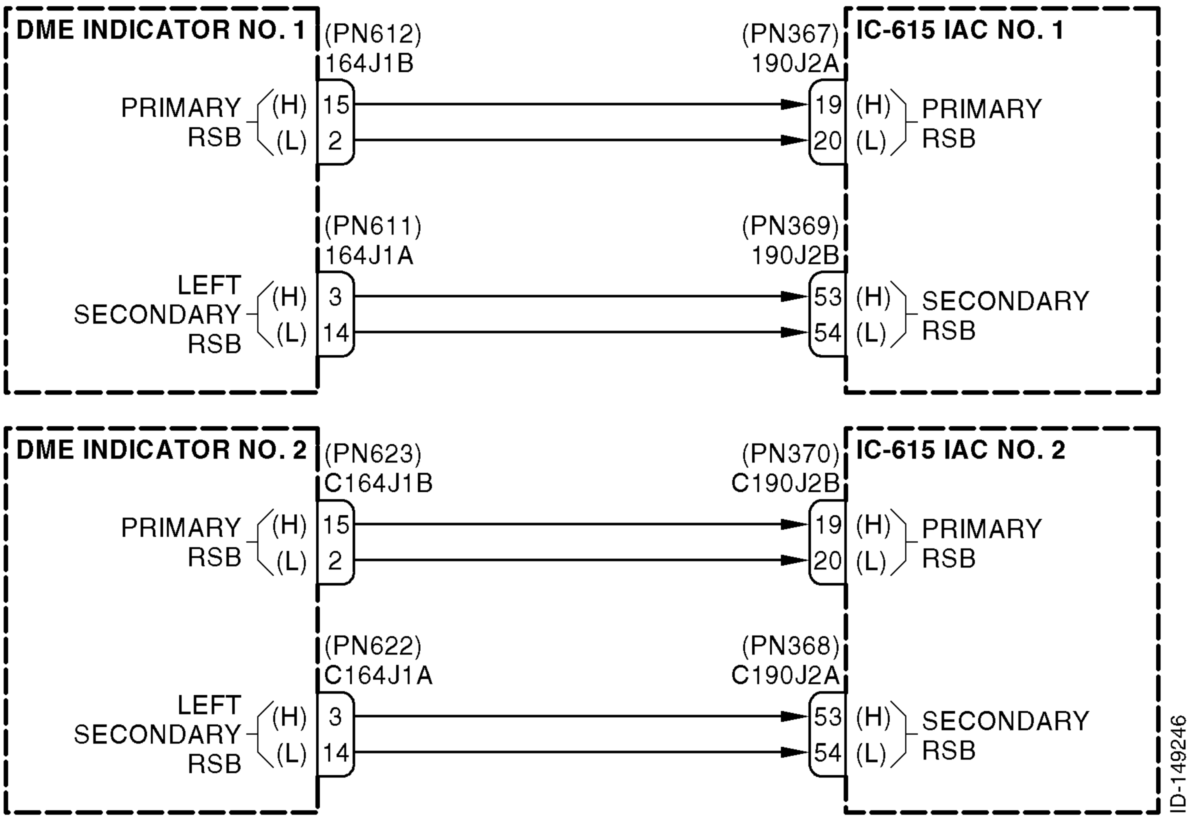

Figure 2-1-17. DME to IC-615 IAC Interface

4 Radio Altimeter Interface

a The IC-615 IAC uses the radio altimeter analog output signal over an analog interface. The Honeywell radio altimeter also provides discrete outputs that trigger at specific altitudes.

b The radio altimeter shown in Figure 2-1-18 supplies a two-wire output of absolute height above the terrain. The IC-615 IACs use this information to do the following:

- Comparison monitor for decision height annunciator
- Display radio altitude on the PFD
- Gain program the localizer and glideslope signals as the aircraft descends below 1,200 ft radio altitude.

c Each IC-615 IAC supplies a test output to start a self-test of the radio altimeter. The output is grounded and the self-test is started when the TEST button on the DC-550 display controller is pushed. Self-test is inhibited by a remote relay when the flight director is in the glideslope capture mode.

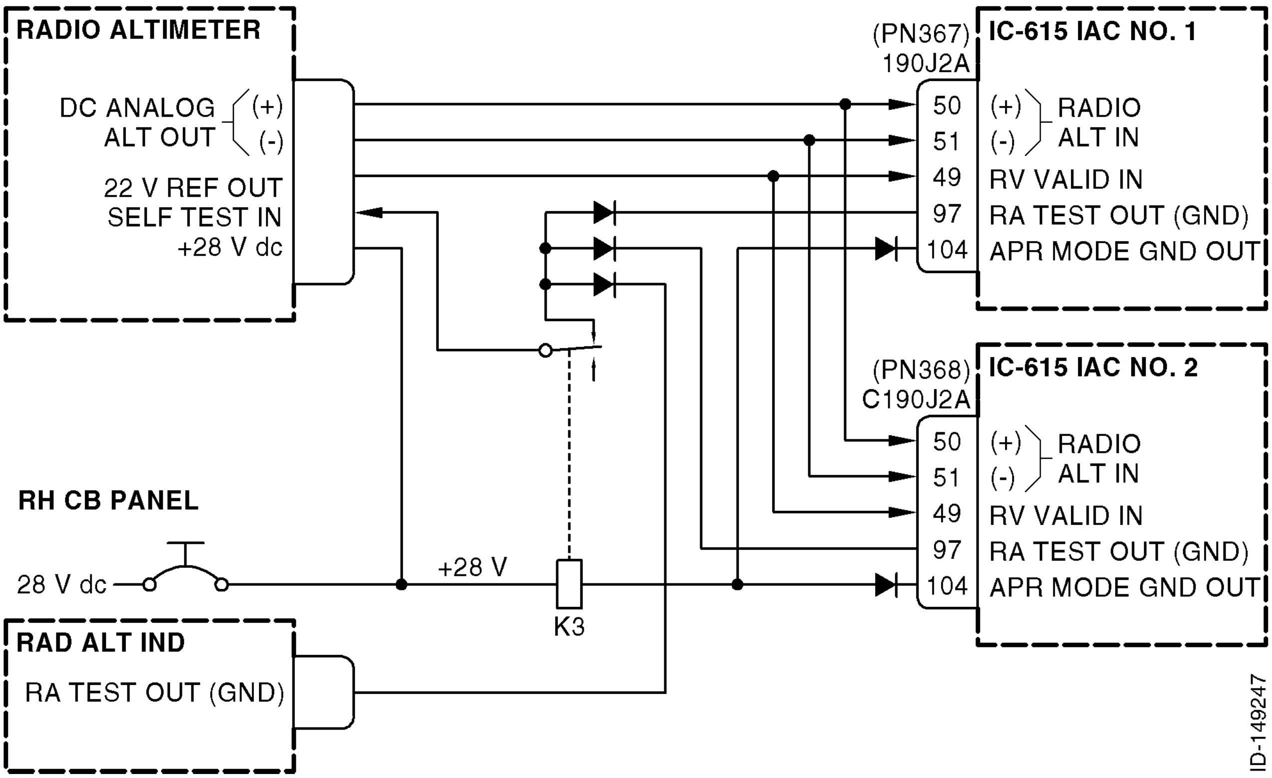

Figure 2-1-18. Radio Altimeter Interface

d The AA-300 radio altimeter supplies an analog radio altitude signal (-4 mV/ft) and a 28 V dc valid. Altimeter output range is -20 to 2,500 ft.

5 LRN Interface

a The IC-615 IAC receives LRN data over a GAMA standard ARINC 429 data bus, as shown in Figure 2-1-19. This data is processed by the IC-615 IAC to display flightplan waypoints, waypoint bearing, desired track, cross track deviation, waypoint distance, and time-to-waypoint. When using LRN, the flight director couples to the roll steering command. The IC-615 IAC also receives a vertical deviation signal for primary flight display purposes only. Table 2-1-14 gives the labels expected from the LRN.

b The IC-615 IAC outputs ARINC 429 XMTR data to be used by the LRN. Table 2-1-15 gives the ARINC labels for the IC-615 IAC outputs.

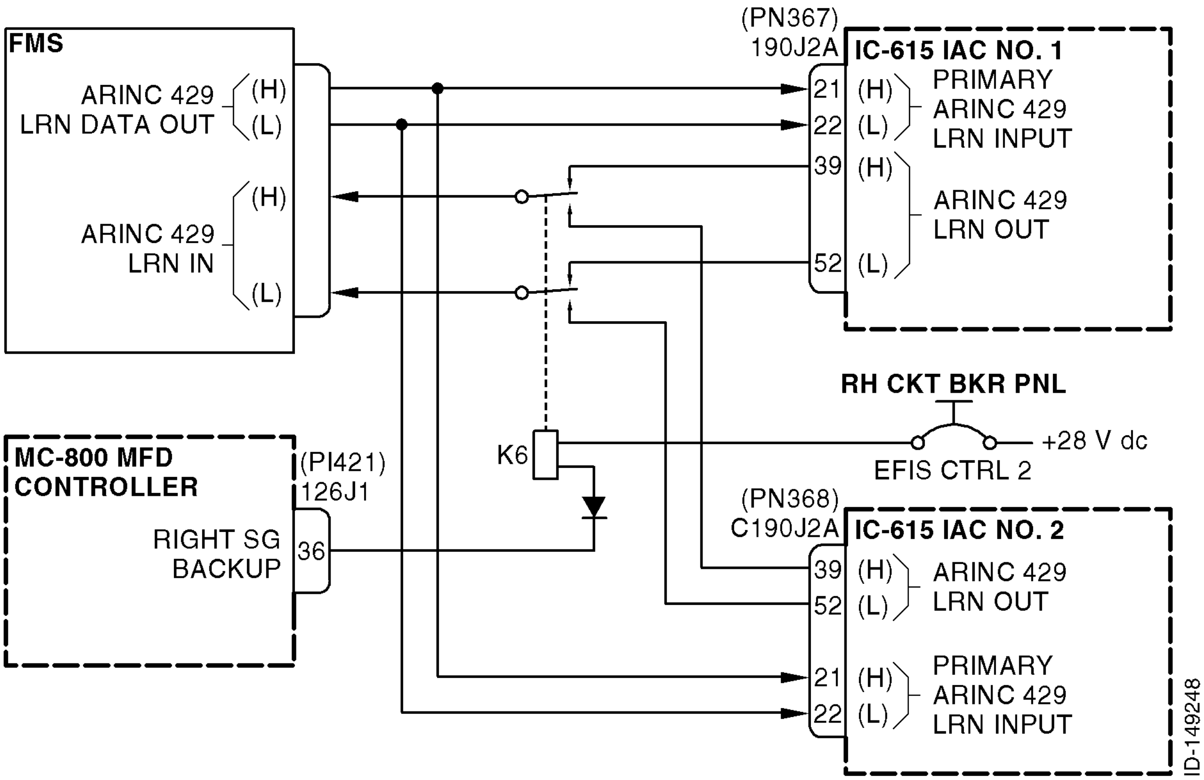

Figure 2-1-19. LRN Interface

Table 2-1-14. LRN ARINC 429 Output Word Labels

Label	Description
075	Waypoint/omni bearing selector
114	Desired track
115	Waypoint bearing
116	Crosstrack distance
117	Vertical deviation
121	Roll steering
147	Magnetic variation
251	Distance
252	TTG
275	To/from, approach, cross track, degrade, dead reckon
276	Bisector distance
312	Groundspeed
315	Windspeed
316	Wind direction

Table 2-1-14. LRN ARINC 429 Output Word Labels (cont)

Label	Description
321	Drift angle
NOTE: The following labels support map data: 074, 113, 300, 301, 302, 303, 304, 305, 306, 307, 310, and 311.	

Table 2-1-15. IAC ARINC 429 Transmitter Outputs

Label	Description
100	Selected course
101	Selected heading
102	Selected altitude
203	Pressure altitude
204	Baro corrected altitude
205	Mach number
206	Calibrated airspeed (IAS for captured vertical)
210	True airspeed
211	Total air temperature
212	Altitude rate
213	Static air temperature
270	IAC status discretes
306	Designator latitude
307	Designator longitude
320	Magnetic heading
324	Pitch attitude
325	Roll attitude
333	Body normal acceleration
371	Equipment ID

(b) Air Data Interface

1 The AZ-950 MADC supplies the primary flight display with baro corrected altitude, true airspeed (requires temperature probe), Mach, and vertical speed information over an ARINC 429 interface as shown in Figure 2-1-8. Each IC-615 IAC receives data from both the No. 1 and No. 2 MADCs. This allows either pilot to revert to the secondary air data source for the PFD. The MADC supplies the output word labels given in Table 2-1-16.

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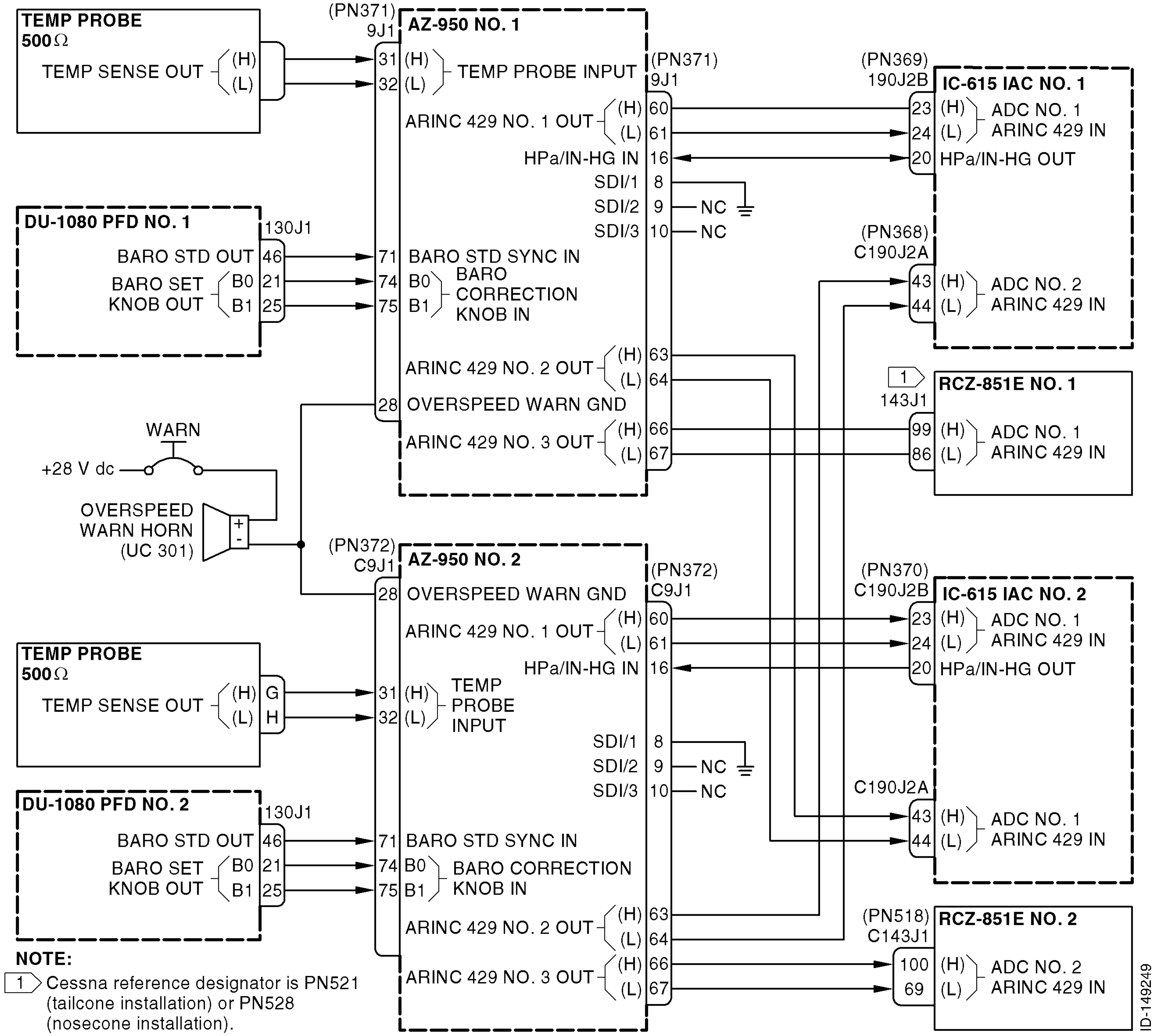


NOTE:

1 Cessna reference designator is PN521 (tailcone installation) or PN528 (nosecone installation).

Figure 2-1-20. MADC Interface

Table 2-1-16. Air Data ARINC 429 Output Word Labels

Label	Description
203	Pressure altitude
204	Baro altitude
205	Mach number
206	Calibrated airspeed
207	Maximum operating speed (Vmo)
210	True airspeed
211	Total air temperature
212	Altitude rate
213	Static air temperature
234	Baro correction - hPa
235	Baro correction - inHg

(c) Display Control Interfaces

1 Control of the displays is straightforward and accomplished with a blend of fixed function buttons, knobs, and multifunction menu selections. The PFDs are controlled by the buttons and knobs on the DC-550 display controller, RI-553 remote instrument controller, and MS-560 mode selector.

2 DC-550 Display Controller Function

a The DC-550 display controller gives the pilot control/change for the display formatting, such as full or partial compass display, or single cue/cross pointer flight director cues. It also supplies a data acquisition function for the display controls that follow:

- DC-550 front panel buttons and switches
- RI-553 remote instrument controller
- MS-560 mode selector
- Attitude and heading reversion switches.

b Button and switch closure inputs from these display controls are encoded into serial data and transmitted to the IC-615 IAC on a two-wire DC-IC digital bus. There is one bit assigned in the message for each button and switch input. The IC-615 IAC is in turn configured through software to assign a function to each bit. Block diagrams of the No. 1 and No. 2 display controller interfaces are shown in Figure 2-1-21 and Figure 2-1-22.

c The controller uses ground/open discrete inputs to interface with other LRUs that supply open logic signals for the on/off condition. The contact of the momentary buttons are connected to ground through the DC-550 connector. Circuit design for input of these discretes includes a 5-ms filter followed by a buffer with a 1-volt hysteresis to eliminate switch chatter. The ON state is defined as ground or less than 2 V dc. The OFF state is defined as open.

d The serial data is a block of 13 8-bit words. Bits 0-6 of all bytes contain actual data. Bit 7 of each byte is used for data synchronization. Bit 7 of the first byte is hardwired to +5 V dc to identify the start of message and bit 7 of the remaining bytes are hardwired to ground to identify data. The last byte in the transmission is a counter that increments every transmission to indicate when new data is on the bus.

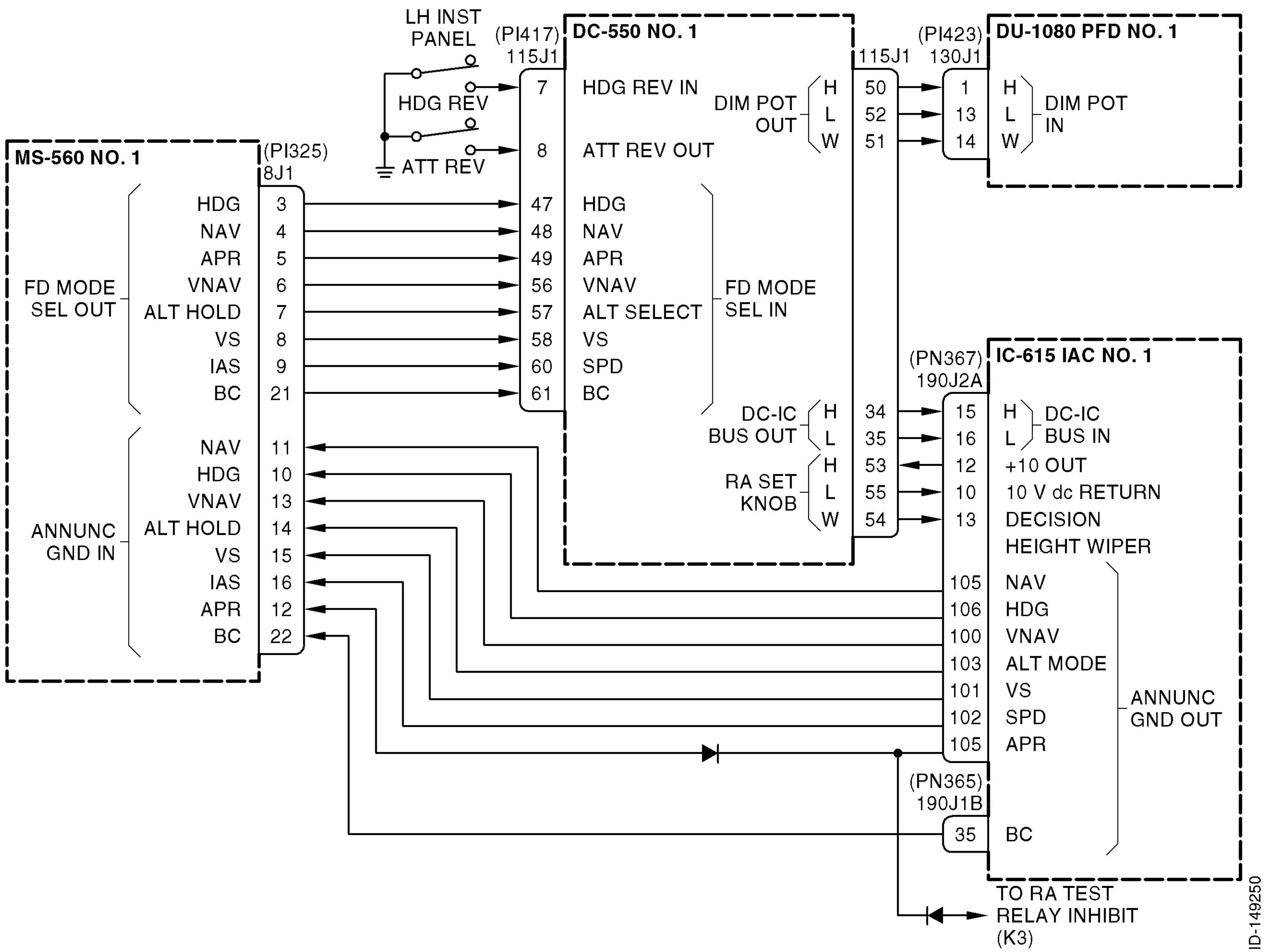


Figure 2-1-21. DC-550 Display Controller Interface (Pilot's)

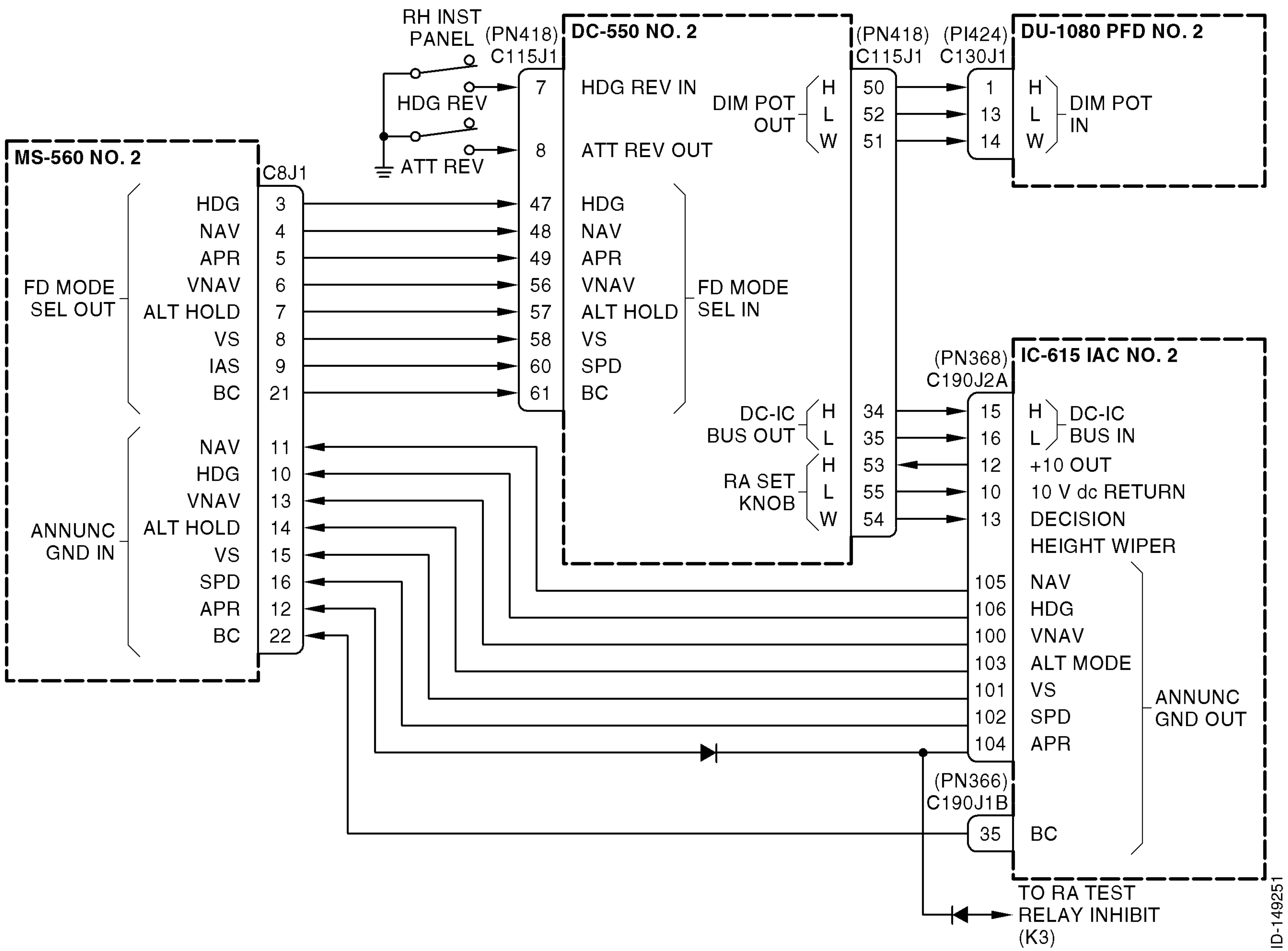


Figure 2-1-22. DC-550 Display Controller Interface (Copilot's)

3 RI-553 Remote Instrument Controller Function

a The RI-553 remote instrument controller is a three-knob controller that controls selected heading and selected course. Figure 2-1-23 shows a block diagram of the interface.

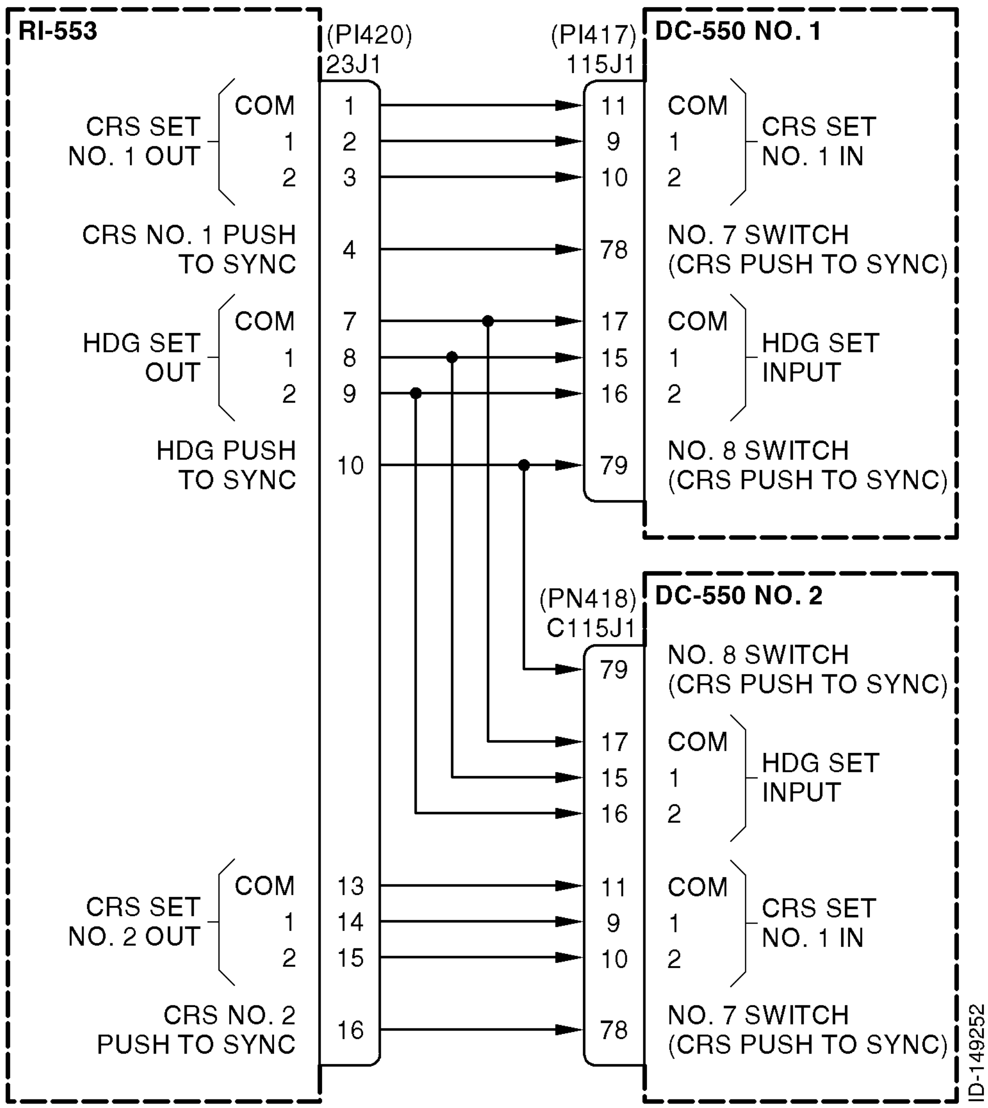


Figure 2-1-23. RI-553 to DC-550 Interface

4 MC-800 Multifunction Controller Functions

a The MC-800 MFD controller lets the pilot select display formats and modes that change the information shown on the MFD. This includes display dimming, map or plan and weather displays, TCAS traffic advisories, resolution advisories, and normal and emergency checklists. The controller also lets the pilot select the display backup mode. See Figure 2-1-24 for a block diagram of the MC-800 interface.

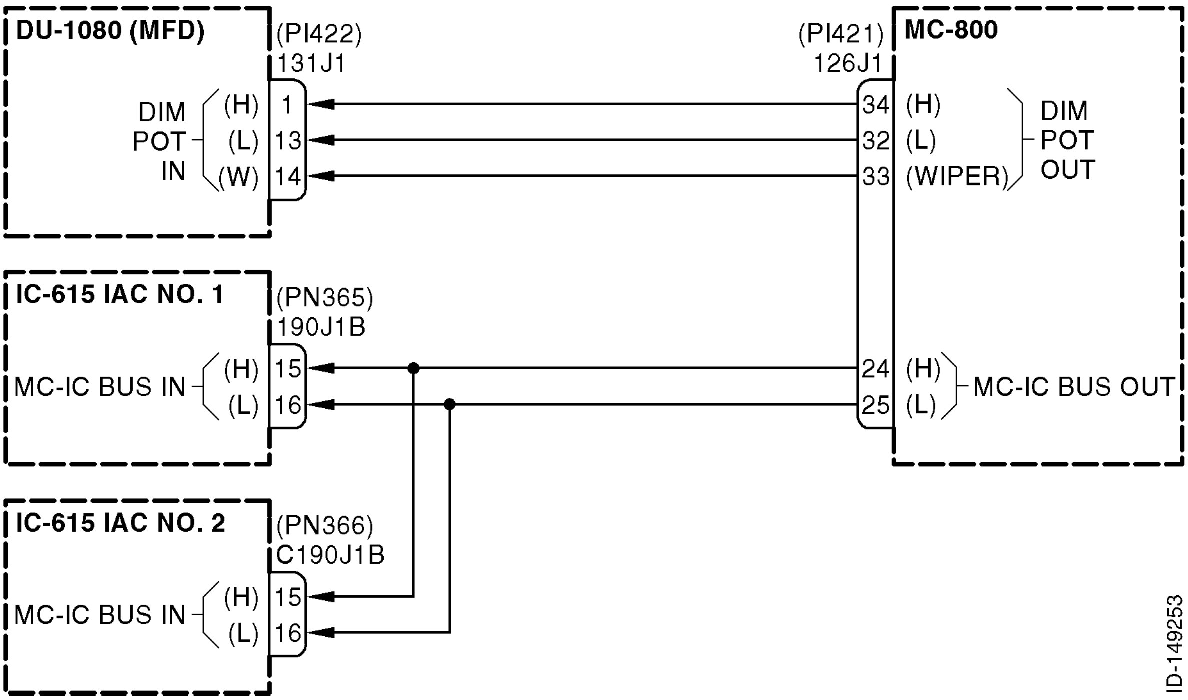


Figure 2-1-24. MC-800 MFD Controller Interface

C. PFD

(1) The PFD is the single cockpit display where all of the required flight and navigation data is displayed. This data includes the following:

- Primary aircraft attitude and heading
- Primary airspeed, altitude, and vertical speed
- Radio altitude
- Marker beacon annunciations
- Reference and alerting data
- Speed bugs
- Comparison monitor alerts
- Navigation data
- Selected course
- Selected heading
- Lateral and vertical deviations
- Bearing pointers
- Flight guidance system data
- Flight director commands
- Mode annunciations
- Excessive deviation alerts.

(a) PFD Functional Divisions

1 General

a The PFD, as shown in Figure 2-1-25, is divided into four functional display areas: ADI display, HSI display, mode annunciations, and air data (airspeed, altitude, and vertical speed displays).

2 ADI Display

a The ADI symbols use a truncated sphere format to display standard attitude information. If AHRS data becomes invalid, all scale markings are removed, the attitude sphere turns cyan, and a red annunciator of ATT FAIL appears at the top center portion of the sphere.

3 HSI Display

a The HSI displays actual aircraft magnetic heading as a function of information received from the AHRS. Selected course and heading inputs are controlled from the RI-553 remote instrument controller. Navigation source annunciator, distance, TO, FROM, lateral deviation, etc., are supplied from the navigation source selected.

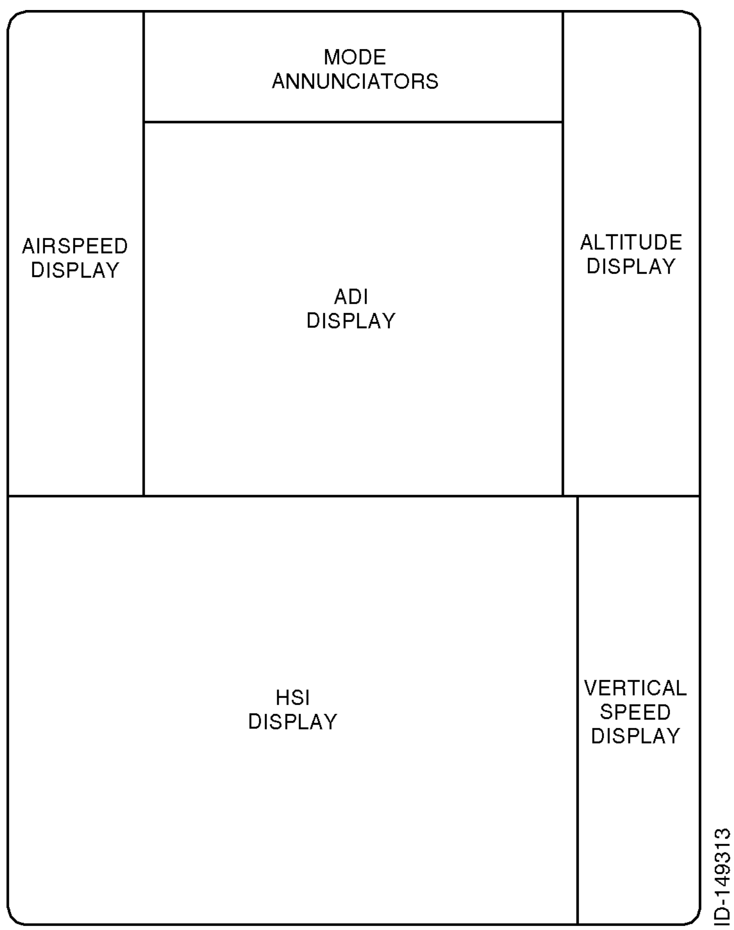


Figure 2-1-25. PFD Functional Divisions

4 Mode Annunciators

a The PFD displays mode annunciators from the flight director, PFD source selections, and comparison monitor function.

5 Airspeed Display

a The airspeed display presents calibrated airspeed and Mach, as sensed by the MADC. Angle of attack (AOA) is displayed, as sensed by the AOA computer and sent to the IC-615 IAC. Speed bug set information is supplied by the appropriate control on the MFD.

6 Altitude Display

a The PFD displays barometric altitude information, as sensed by the MADC. The baro set is controlled from the PFD and altitude preselect displays are controlled from the MFD.

7 Vertical Speed Display

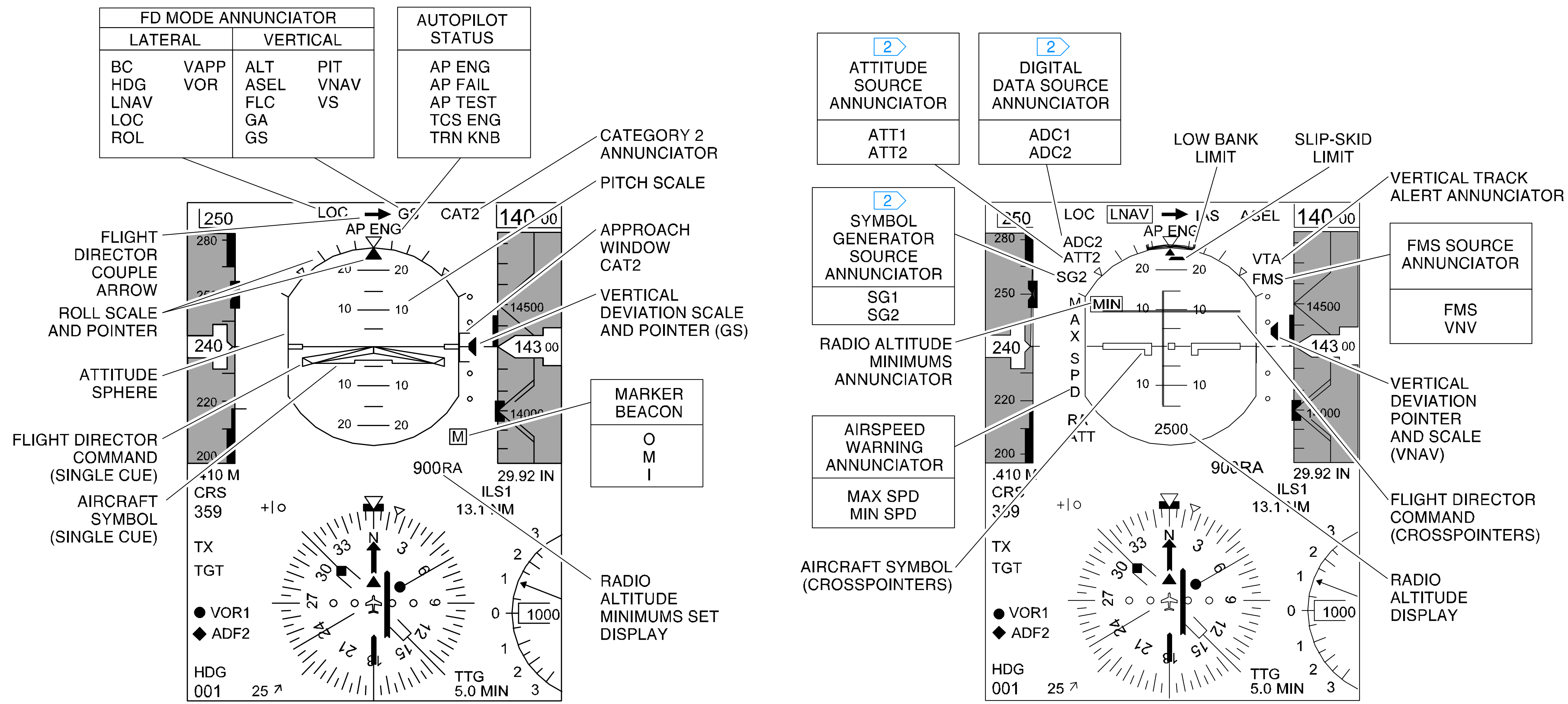
a Vertical speed information is displayed, as sensed by the MADC. Vertical speed target bug information is displayed as set via the MFD when the vertical speed mode is operational.

NOTE: Various other display data, such as radio altitude, marker beacon, and states of operation annunciators are also displayed on the PFD.

(b) PFD ADI Display and Annunciators

1 The ADI supplies the following display information, as shown in Figure 2-1-26:

- Sphere-type attitude display
- Glideslope or vertical deviation
- Radio altitude
- Radio altitude minimums display and annunciator
- Flight director mode annunciators
- Source annunciations for attitude and air data
- SG reversion mode annunciator
- Comparison monitor annunciators
- CAT 2 ILS mode annunciator
- Marker beacon annunciation
- Autopilot status messages.



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NOTES:

1. Symbol is shown for format and location. Not all the symbols shown may simultaneously occur on an actual display.
2. Source annunciators not displayed when normal onside source is selected, unless both pilots are using the same source.
3. Comparison monitor annunciators are displayed in various locations on the ADI and HSI displays.

Figure 2-1-26. PFD ADI Displays and Annunciators

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2 Flight Director Mode Annunciators

a The flight director mode annunciators are displayed full-time on both PFDs, above the attitude sphere. Lateral modes are shown on the top left side of the PFD. Vertical modes are shown on the top right side of the PFD. Captured modes are shown in green characters. Armed lateral modes are shown in white characters to the left of the captured modes. Armed vertical modes are shown in white characters to the right of the captured modes. Refer to Table 2-1-17 and Table 2-1-18 for a list of the flight director mode annunciators.

Table 2-1-17. Lateral Mode Annunciators

Annunciator	Description	Mode States
BC	Back course	Arm or capture
HDG	Heading select	Capture only
LNAV	Lateral navigation	Capture only
LOC	Localizer	Arm or capture
ROL	Basic roll mode	Capture only
VAPP	VOR approach	Arm or capture
VOR	VOR	Arm or capture

Table 2-1-18. Vertical Mode Annunciators

Annunciator	Description	Mode Status
ALT	Altitude hold	Capture only
ASEL	Altitude preselect	Arm or capture
FLC	Flight level change	Capture only
GA	Go-around	Capture only
GS	Glideslope	Arm or capture
PIT	Pitch basic mode	Capture only
VNAV	Vertical navigation	Arm or capture
VS	Vertical speed	Capture only

b For modes that transition from arm to capture, a white box is drawn around the capture or hold mode annunciator for 5 seconds after the capture logic is satisfied.

(1) The lateral transitions are as follows:

- VOR arm to VOR capture
- LOC arm to LOC capture
- BC arm to BC capture
- VAPP arm to VAPP capture.

(2) The vertical transitions are as follows:

- ASEL arm to ASEL capture
- ASEL capture to ALT capture
- VNAV capture to ALT capture
- VNAV capture to IAS capture.

3 Autopilot Status Messages

a Autopilot system status is determined by the IC-615 IAC and displayed above (top center) the attitude sphere. During normal autopilot operation, a green AP ENG message is displayed. Amber warnings replace this message under appropriate conditions. Refer to Table 2-1-19 for a list of autopilot system messages.

b Only one message can be displayed at any given time. Autopilot failure is indicated by an amber AP FAIL in place of the AP ENG annunciation. Similarly, activation of the TCS submode is indicated by an amber TCS ENG if the autopilot is engaged when the TCS switch is pushed.

Table 2-1-19. Autopilot Status Annunciations

Annunciator	Color	Message
AP ENG	Green	Autopilot engaged
AP FAIL	Amber	Autopilot has failed
AP TEST	Amber	Power-up test
TCS ENG	White	Touch control steering engaged
TRN KNB	Amber	Autopilot turn knob is out of detent

4 CAT 2 ILS Annunciator

a The symbol generator supplies a green or flashing amber CAT 2 category annunciator on the PFD. These mode annunciations are located above the vertical deviation scale. It also supplies a green CAT 2 approach window on the vertical deviation display.

(1) The green CAT 2 mode annunciation is an indication that the excessive ILS deviation monitors are active on the PFD.

(2) The symbol generator activates the CAT 2 mode annunciator on the PFD whenever approach (APR) mode is selected and the following criteria are satisfied:

- Both display controllers RA setting must be less than 200 ft and radio altitude must be valid.
- Onside radios must be selected for display, both tuned to the ILS, and the localizer and glideslope deviations must be valid.
- Two symbol generators must be operational and they cannot be selected in SG reversion.
- One radio altimeter (minimum) must be valid.

b If the above criteria are not met when APR mode is selected, it is assumed that the pilot does not desire to shoot the ILS approach with the CAT 2 monitors active. There is no CAT 2 approach annunciator given on the PFD in this case.

5 CAT 2 Excessive Deviation Monitors (Optional)

a When the CAT 2 mode annunciation is displayed, the ILS excessive deviation monitors are active. If the localizer deviation exceeds the CAT 2 window requirements, with radio altitude less than 500 ft, the deviation and scale is changed from green to flashing amber. The display reverts back to green if the deviation is brought back within the appropriate threshold. The same logic and symbols apply to the glideslope deviation scale. In addition, the CAT 2 annunciation turns amber and flashes. The monitors are independent with the thresholds set in accordance with regulatory agencies' requirements for CAT 2 ILS operations.

6 Pitch Scale and Pointer

a The pitch scale tape shown in Figure 2-1-27 has reference marks every 5 degrees between 10 and 30 degrees. Red fly-down pitch warning chevrons appear at 45 and 65 degrees pitch up, and fly-up warning chevrons appear at 35, 50, and 65 degrees pitch down. The size of the pitch warning chevrons increase as pitch attitude exceeds these values. Pitch movement is hard limited to ± 90 degrees (accuracy ± 30 minutes).

7 Vertical Deviation Scale and Pointer

a The vertical deviation scale (white dots) and pointer are located on the right side of the attitude sphere. The deviation pointer is a fly-to indication, and can be driven from one of the following sources:

- Glideslope from an SRN receiver (pointer is displayed as a green triangle)
- VNAV computer (pointer is displayed as a magenta triangle)
- FMS for VNAV (pointer is displayed as a magenta triangle).

b The navigation source is selected through buttons on the DC-550 display controller. When the vertical deviation is supplied by an FMS, a white FMS annunciator is displayed above the scale. When vertical deviation is supplied by the VNAV computer, a white VNAV is displayed above the scale. If invalid glideslope (SRN) information is received, the pointer is removed and a red **X** is drawn through the scale. The scale is removed for invalid FMS or VNAV computer data.

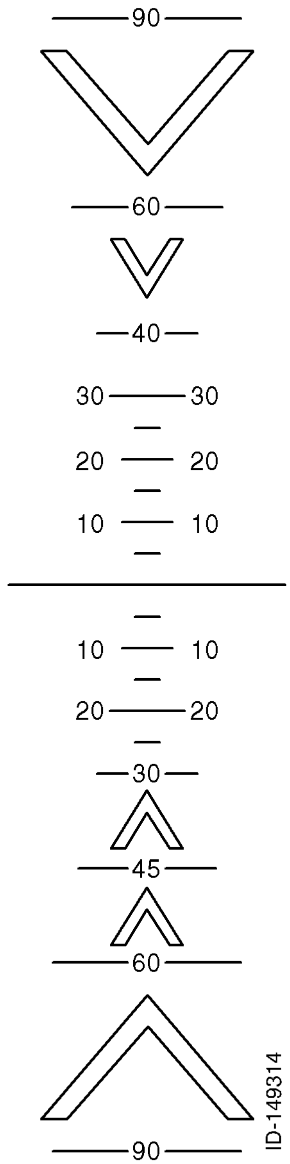


Figure 2-1-27. ADI Pitch Scale

c Glideslope Display

(1) The PFD can display glideslope data from the tuned (No. 1 or No. 2) SRN radio receiver through the IC-615 IAC. Pointer movement for glideslope deviation is given in Table 2-1-20.

d VNAV Display

(1) The PFD can display data from the FMS or VNAV computer through ARINC 429 inputs whenever the data is valid. The IC-615 IAC receives data from the FMS and VNAV computer in feet. Pointer movement for VNAV deviation is given in Table 2-1-20. The values for pointer movement collapse inward as a function of FMS approach mode.

Table 2-1-20. Vertical Deviation Scale

Pointer Position	Glideslope	VNAV	FMS APP
2nd dot up	+150 ± 5 μA	+500 ft	+150 ft
1st dot up	+75 ± 5 μA	+250 ft	+75 ft
Zero index	0 ± 5 μA	0 ft	0 ft
1st dot down	-75 ± 5 μA	-250 ft	-75 ft
2nd dot down	-150 ± 5 μA	-500 ft	-150 ft
Partially in view	< +350 ± 5 μA > -350 ± 5 μA	< +1166 ft > -1166 ft	N/A

8 Marker Beacon

a The marker beacons are displayed below the attitude sphere in the lower right corner. Specific symbols and colors are assigned to the markers as shown in Table 2-1-21.

Table 2-1-21. Marker Beacons

Marker	Color
O (outer)	Blue
M (middle)	Amber
I (inner)	White

b Detection of a marker causes the symbol to flash. A white box identifies the location of the active marker beacon annunciator after tuning an ILS frequency on the selected navigation receiver (if the flight director back course mode is not armed or captured). When multiple marker inputs are active at the same time, the marker beacon symbols are displayed horizontally with the appropriate colors. Inactive or invalid marker beacon symbols are removed from the display.

9 Radio Altitude Minimums Set Display (RA)

a The radio altitude RA set data is located below the attitude sphere, in the lower right corner. The range for RA set is 5 to 999 ft. The RA value can be set between 5 and 200 ft (within 5 ft) AGL, and between 200 and 2,500 ft (within 10 ft) AGL. Above 2,500 ft AGL, the set data is removed. When the radio altitude data is invalid, the display indicates a dash in each of the digits. Each time a radio altitude value is set with the DC-550 display controller RA knob, the set value reappears for 5 seconds.

10 Aircraft Symbol

a This symbol serves as a stationary representation of the aircraft and is always displayed in the center of the attitude sphere. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed miniature aircraft (yellow) and the movable sphere. The miniature aircraft is flown to align the command cue to the aircraft symbol to satisfy the commands of the selected flight director mode.

b The shape of the aircraft symbol and the flight director pitch and roll command bars are selectable as either a cross pointer (CP) or single cue (SC) display. Power-up condition is with the single cue displayed. The cross-pointer is selected by the SC/CP button on the DC-550 display controller. Successive toggling of the SC/CP button changes the display back and forth from single cue to cross-pointer.

11 Flight Director Command Bars

a The flight director gives pitch and roll commands to the pilot by displaying single cue or crosspointer command bars on the attitude sphere. The type of command bar displayed is selected by using the SC/CP button on the display controller. Command bars are displayed only when a lateral and vertical mode has been selected. The pilot flies the aircraft symbol to the flight director command bar(s) to capture and maintain a desired flightpath. The pitch command is limited to ±20 degrees and roll command is limited to ±30 degrees.

b If the flight director becomes invalid, the command bars are removed from the display.

12 Attitude Sphere

a The colors for the attitude sphere are cyan for the sky, brown for the earth, and white for the horizon line. The sphere moves with respect to the symbolic aircraft reference to display actual pitch and roll attitude.

13 Roll Scale and Pointer

a The roll scale is linear with white markings at 10, 20, 30, 45, and 60 degrees of roll. The 30-degree mark is highlighted with a double-stroke tick mark. A triangle marks 45 degrees of roll. Roll movement is 360 degrees, with ±50 minutes accuracy.

14 Flight Director Couple Arrow

a A green arrow is displayed above the attitude sphere (top center) to indicate which flight director (FD1 or FD2) is coupled to that PFD for lateral and vertical sensor inputs.

15 Attitude and Digital Air Data Source Annunciators

a The PFD annunciates the following sources of display:

- Attitude gyro (ATT)
- Micro air data computer (ADC).

b When the normal (onside) source is selected, the mode annunciators are suppressed. The onside mode is defined in Table 2-1-22. The mode annunciators are normally white, but when the pilot and copilot are on the same source, the annunciation turns amber on both displays.

Table 2-1-22. Onside Source Mode Annunciators

Sensor	No. 1 PFD	No. 2 PFD	Location
Attitude	ATT1	ATT2	Upper left of ADI
MADC	ADC1	ADC2	Upper left of ADI

16 Low Bank Limit

a The low bank limit indications are displayed as green tick marks at the 14-degree position on the roll attitude scale. They are a visual indication of flight director bank limits and are displayed only when the flight director is valid.

17 Slip-Skid Indicator

a An electronic slip-skid indicator in the top center of the attitude sphere, just below the roll pointer, moves 1.85 in. for each 1g of lateral acceleration.

18 Vertical Track Alert (VTA) Annunciator

a An amber VTA is displayed above the vertical deviation scale, as appropriate, when VNAV is selected. The input is supplied by the selected FMS.

19 FMS Source Annunciator

a The FMS source is annunciated as either the FMS itself or VNV for vertical navigation.

20 Radio Altitude Display

a The four-digit display, located at the bottom of the attitude sphere, indicates the aircraft's radio altitude from -20 to 2,500 ft. The resolution above 200 ft of altitude is 10 ft; below 200 ft, the resolution is 5 ft. The display is blanked for altitudes greater than 2,550 ft. When the radio altitude data is invalid, the display indicates a dash in each of the digits.

21 Airspeed Warning Annunciator

a When the flight director detects an overspeed or underspeed condition, a MAX SPD or MIN SPD warning is displayed in amber to the left of the sphere. The warning remains as long as the flight director determines the overspeed or underspeed condition exists.

22 Radio Altitude Minimums Annunciator

a The RA minimums annunciator is displayed under two conditions: armed and captured. The annunciator is armed when the aircraft WOW indicates airborne and RA minimums is valid (RA $\geq$ RA minimums setting + 100 ft for 5 seconds). When these conditions exist and actual radio altitude decreases to within 100 ft of the RA minimums, the annunciator turns black with an amber box drawn around it. The armed condition continues until the aircraft WOW indicates the aircraft is on the ground or RA is 100 ft greater than RA minimums.

b RA minimums does not transition to the captured phases unless it was first armed. The captured condition exists when the RA $\leq$ RA minimums setting. When the captured condition occurs, a boxed MIN with a black background is displayed. At capture, the MIN annunciator flashes for 10 seconds. If the aircraft moves out of the capture condition, the MIN annunciator is removed from the PFD.

23 Symbol Generator Source Annunciators

a When a symbol generator reversion mode (SG1 or SG2) is selected on the MC-800 MFD controller, the source is annunciated in the upper left corner, above the attitude sphere on both PFDs. An amber SG1 indicates the IC-615 IAC No. 1 is driving all three displays (No. 2 PFD is a duplicate of the No. 1 PFD). An amber SG2 indicates the IC-615 IAC No. 2 is driving all three displays (No. 1 PFD is a duplicate of the No. 2 PFD). Symbol generator source is shown on all PFD formats.

24 Comparison Monitor Annunciators

a A variety of comparison monitor annunciators are provided. Selected pilot and copilot data inputs are monitored within the IC-615 IAC for reasonableness between onside and cross-side display data (through the IC bus). If the difference between the data exceeds a predetermined trip criteria, the miscompare is annunciated in amber on the PFD. Table 2-1-23 gives the miscompare annunciations, locations, and trip criteria. Active messages are cleared when the miscompare situation has been corrected.

b When the pitch and roll attitude or glideslope and localizer signals are miscompared, a combined message (ATT or ILS) is displayed. If the radio altimeter is invalid, localizer and glideslope comparison monitoring are activated as functions of GS capture (CAP). LOC, GS, and ILS comparisons are only active during flight director LOC and GS capture with both NAV receivers tuned to a LOC frequency.

Table 2-1-23. Comparison Monitor Annunciators

Annunciator	Location	Trip Criteria
ROL	Below and to the left of the attitude sphere	±6 degrees roll attitude
PIT	Below and to the left of the attitude sphere	±5 degrees pitch attitude
ATT	Below and to the left of the attitude sphere	Pitch and roll as stated above
HDG	Below and to the left of the attitude sphere	±6 degrees if roll attitude < 6 degrees ±12 degrees if roll attitude > 6 degrees
ALT	Altitude tape, upper right corner (top inside)	Altitude ±200 ft
IAS	Airspeed tape, upper left corner (top inside)	Airspeed ±5 knots
RA	Below and to the left of the attitude sphere	>10 ft $+(\Sigma_{RA}) \cdot (0.0625)$
GS	Below and to the left of the attitude sphere	GS CAP and below 1200 ft by a difference of ±50 μA GS deviation
LOC	Below and to the left of the attitude sphere	APP mode below 1200 ft by a difference of ±40 μA LOC deviation
ILS	Below and to the left of the attitude sphere	LOC and GS as shown above

(c) PFD HSI Display

1 The HSI presents a map-like display of the aircraft position. The HSI displays aircraft displacement relative to VOR radials, localizer, and glideslope beam, as well as LRN cross-track deviation.

2 The HSI display can be presented in two basic formats, full or partial (arc) compass modes. In the full compass mode, 360 degrees of heading is displayed, and partial compass presents 90 degrees of heading. Weather information can also be displayed in the partial mode. Power-up condition is with full compass displayed. Partial compass is selected through a button (HSI) on the DC-550 display controller. Successive toggling of the HSI button changes the display back and forth from full compass to partial compass display.

3 The HSI full compass displays are as follows:

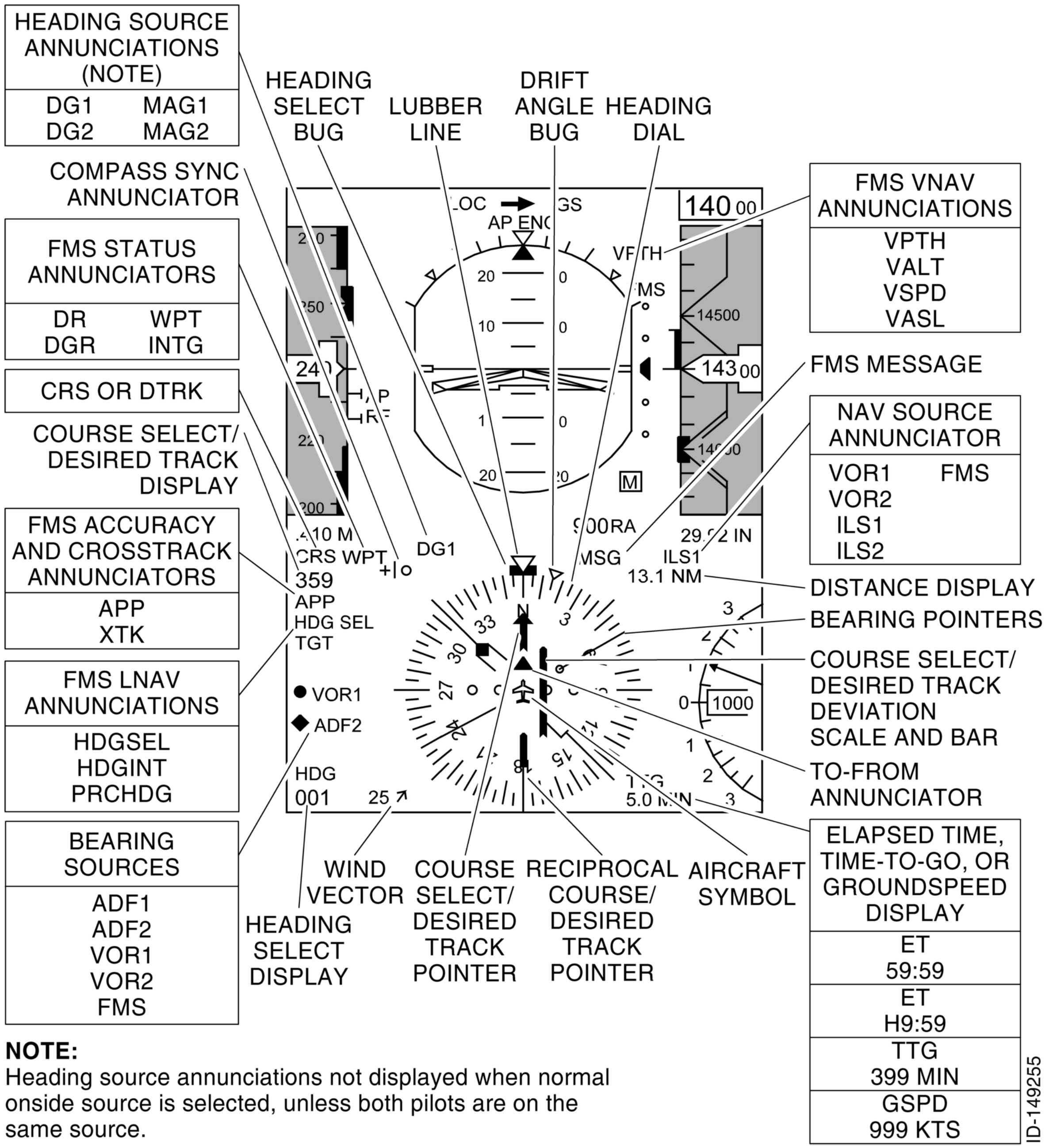
- Heading
- Course select
- Course deviation
- Distance
- Groundspeed
- To/from
- Wind vector
- Desired track
- Bearing 1 and 2
- Heading select
- TTG
- Elapsed time
- Heading and NAV source annunciators
- Compass sync.

4 The HSI partial compass displays are as follows:

- Navigation map (range annunciator and waypoints)
- Multiple waypoints
- Heading bug off-scale arrows
- Weather information.

5 HSI Full Compass Format

a The HSI annunciators on the PFD are shown in Figure 2-1-28.



NOTE:
Heading source annunciations not displayed when normal onside source is selected, unless both pilots are on the same source.

Figure 2-1-28. HSI Compass Display on PFD

b Compass Sync Annunciator

(1) The green compass sync annunciator indicates the state of the compass system in the slaved (AUTO) mode. The bar represents commands to the directional gyro to slew the indicated direction. Input range for bar movement is 400 mV: +200 mV for (+) to indicate increased heading, zero for center to indicate no deviation, and -200 mV for ○ to indicate decreased heading. The compass sync is removed during compass MAN (DG) mode or while the cross-side compass is selected.

c Heading Source Annunciators

(1) The PFD annunciates (upper left of HSI) the following sources of heading display:

- Directional gyro (DG)
- Magnetic compass (MAG).

(2) The onside and cross-side mode annunciators are defined in Table 2-1-24. Mode annunciators are normally white, but when the pilot and copilot are on the same source, the annunciators turn amber on both displays.

Table 2-1-24. Heading Source Annunciators

No. 1 PFD		No. 2 PFD	
Onside Source	**Cross-Side Source**	**Onside Source**	**Cross-Side Source**
Not displayed	DG2	Not displayed	DG1
Not displayed	MAG2	Not displayed	MAG1

d Heading Select Bug

(1) The notched solid cyan heading bug rotates about the compass and is displayed full time, unless off scale in partial compass (arc) format. The heading bug is positioned by rotating the heading select knob on the RI-553 remote instrument controller.

(2) The bug rotates with the heading dial; therefore, the difference between the bug and the fore lubber line index is the amount of heading select error applied to the flight director.

e Lubber Line

(1) The lubber line is drawn as a white triangle. The triangle is positioned at the apex of the compass, outside the azimuth ring. The triangle fits inside the heading bug when the heading bug is positioned at 0 degrees. Angular error between the heading input and the displayed heading, as read against the lubber line, is less than ±50 minutes. Other symbols related to the lubber line are seven tick marks, positioned at 45-degree intervals around the outside of the compass proper.

f Drift Angle Bug

(1) Selection of long range NAV causes the drift angle bug to be displayed. If available from the FMS, the drift angle bug with respect to the lubber line represents drift angle left or right of the desired track. The drift angle bug with respect to the heading dial represents the aircraft's actual track. The bug is displayed as a green triangle that moves around the outside of the heading dial (in either full or partial modes).

g Heading Dial (Full)

(1) Gyro stabilized magnetic compass information is displayed on the heading dial, which rotates with the aircraft throughout 360 degrees. The compass (azimuth) ring is composed of long and short tick marks (white) that alternate every 5 degrees.

(2) Digits and cardinal abbreviations are spaced in 30-degree increments around the inside of the compass. Numeric identifiers are present at 30, 60, 120, 150, 210, 240, 300, and 330 degrees. These digits represent tens and hundreds of degrees at their respective locations.

h FMS VNAV Annunciators

(1) The FMS VNAV annunciators are displayed in the upper right of the ADI. They are displayed in magenta if the onside primary LRN navigation source is selected. They are displayed in yellow if the onside secondary LRN navigation source is selected, or if the onside and cross-side LRN navigation sources are set to the same source.

i NAV Source Annunciator

(1) The annunciation of NAV source appears in the upper right corner of the HSI area. Available navigation sources are VOR 1/2, ILS 1/2, and FMS. The color of the annunciator label changes as a function of the NAV source selected for display. If the pilot and copilot are on the same source, the label is turned to amber.

(2) The selected NAV source for display on the course deviation indicator is transmitted from the onside display controller. If the onside controller is invalid, the SG function reverts to onside primary NAV (i.e. , No. 1 side - VOR1, No. 2 side - VOR2). When tuned to a localizer, the VOR portion of the label changes to ILS. For long range NAV, the source is always identified with FMS.

j FMS Message

(1) A flashing MSG is displayed at the location shown in Figure 2-1-28 when a message is displayed in the scratchpad of the FMS display unit. The annunciator flashes until the pilot takes action according to the aircraft's FMS installation.

k Distance Display

(1) The digital distance readout is always shown below the NAV source annunciators (upper right corner of the HSI area). The color of the distance digits also changes as a function of the NAV mode selected for display. NAV modes and colors of the distance digits (green, yellow, or magenta) change as a function of the NAV source selected for display.

(2) The digits represent the value for distance in nautical miles to the station for a short range NAV and the distance to the next waypoint for long range NAV. Depending on equipment, the distance is displayed in a 0-399.9 or a 0-3999 nautical-mile format. If DME hold is selected when the VOR is displayed, an amber H appears next to the DME distance readout.

l Bearing Pointers and Sources

(1) Two bearing pointers are available, ○ and ◇. The bearing pointers indicate bearing to the selected navaid. The pointers are selected on or off from the DC-550 display controller. Angular error between the bearing input and the displayed bearing is less than ± 1 degree.

NOTE: ADF bearing is case referenced and SRN and LRN are card referenced.

(2) Annunciators for the bearing pointers appear in the lower left-hand corner of the HSI area. The bearing source annunciators are symbol and color coded to match the bearing pointers. The annunciator and bearing pointer color is cyan for the circle pointer (left-side source) and white for the diamond pointer (right-side source). Selectable sources for each pointer are given in Table 2-1-25.

Table 2-1-25. Bearing Sources

BRG ○	BRG ◇	Reference
VOR1	VOR2	Card
ADF1	ADF2	Case
FMS	---	Card

(3) When the bearing pointer navigation source is invalid or a localizer frequency is chosen, the respective bearing pointer is removed. If the bearing pointers are selected off, the annunciator symbols ◇ and ○ are removed from the display, in addition to the pointers being removed.

(4) The pointers rotate about the heading dial in the same manner as the course pointer. Bearing pointer source selections come from the onside DC-550 display controller. If the onside display controller fails, the default sources are VOR1 on circle and VOR2 on diamond.

m Course Select/Desired Track Deviation Scale and Bar

(1) A course select/desired track (lateral) deviation scale appears in the form of two white dots on either side of the aircraft symbol. This represents NAV deviation from the selected source. The lateral deviation dots rotate around the center of the fixed aircraft symbol. The deviation bar represents the centerline of the selected VOR or localizer course. The aircraft symbol pictorially shows actual aircraft position in relation to the selected course. Bar movement for lateral deviation is given in Table 2-1-26.

Table 2-1-26. Lateral Deviation Scale

Pointer Position	VOR Computed	ILS	Cross-Track
2nd dot, right	+10 ± 0.25 degrees	+150 μA	+5.0 NM
1st dot, right	+5 ± 0.25 degrees	+75 μA	+2.5 NM
Zero index	0 ± 0.25 degrees	0 μA	0 NM
1st dot, left	-5 ± 0.25 degrees	-75 μA	-2.5 NM
2nd dot, left	-10 ± 0.25 degrees	-150 μA	-5.0 NM
NOTE: When FMS approach mode is active, cross-track distance is 0.625 NM per dot (four times as sensitive).			

(2) In VOR operation, each dot on either side of the aircraft symbol represents 5-degree deviation from centerline (75 μA). In ILS operation, each dot represents 1-degree deviation from centerline (75 μA). When FMS is the selected navigation source, each dot represents 2.5 NM of crosstrack error. When the FMS APP annunciator is displayed, each dot represents 0.625 NM of cross-track error. Beyond the second dots, the deviation bar continues to move at reduced sensitivity for inputs up to ±12 degrees for computed VOR, ±185 μA for ILS, and ±6.2 NM for cross-track (±1.55 for approach mode).

(3) When the back course mode is selected on the flight director, or when tuned to a localizer frequency and the selected course is more than 90 degrees from the aircraft heading, course deviation is automatically reversed to provide proper deviation sensing with respect to the course centerline. The color (green, amber, or magenta) of the deviation bar changes as a function of the NAV source and onside mode (pilot/copilot).

n ET, TTG, or GSPD Display

(1) The shared display and annunciators for ET, TTG, and GSPD are located at the bottom of the HSI region, between the vertical speed scale and heading compass. The ET button on the DC-550 display controller replaces GSPD/TTG with a digital clock display. When in the ET mode, the ET display can present minutes and seconds up to 59:59. Leading zeros are displayed for values $\leq$ 9 minutes. It also displays hours/minutes up to 9:59. The hour/minute mode is distinguishable from the minute/seconds mode by an H on the left of the digital display. Leading zeros are not displayed for the hour/minute mode.

(2) Successive toggling of the GSPD/TTG button on the DC-550 display controller allows GSPD or TTG to be alternately displayed. The display format for groundspeed is knots and the range is 0-999, $\pm$1 knot. If VOR/LOC is displayed, the HSI displays groundspeed from the associated DME. If FMS is displayed, groundspeed is calculated by the FMS.

(3) The display format for TTG is minutes and the range is 0-399, $\pm$1 minute.

o TO/FROM Annunciator

(1) The TO/FROM indicator appears as a white triangle in front of the aircraft (TO) or behind the aircraft (FROM). A TO indication appears as long as the selected course pointer is within $\pm$90 degrees of the selected NAV source bearing. The TO/FROM annunciator is not in view during localizer operation.

p Reciprocal Course/Desired Track Pointer

(1) The pointer indicates 180 degrees from the course select/desired track pointer.

q Aircraft Symbol

(1) The center of the heading compass has a fixed miniature aircraft symbol (white) and lateral deviation scale. The symbol shows aircraft position and heading with respect to the rotating heading dial. It also shows the aircraft position in relation to a radio course.

r Wind Vector

(1) Wind vector information (which comes from the FMS) is displayed in the left of bottom center. The wind is shown in magenta with velocity and direction. In this presentation, wind information is supplied by a vector arrow showing the direction of the wind relative to the airplane symbol. The associated digital quantity indicates wind velocity.

s Heading Select Display

(1) A digital readout (cyan) of the heading bug's current selected value is displayed in the lower left corner of the HSI region. The selected heading is annunciated with a cyan HDG label above it. Deviation between the heading display and HDG SEL bug, as read against the heading scale, is limited to ±1 degree.

t FMS LNAV Annunciators

(1) The FMS LNAV annunciators are displayed in the upper left of the HSI. They are displayed in magenta if the onside primary LRN navigation source is selected, and in yellow if the onside secondary LRN navigation source is selected, or if the onside and cross-side LRN navigation sources are set to the same source.

u FMS Accuracy and Crosstrack Annunciators

(1) The FMS status messages that follow are annunciated to the left of the compass:

- FMS approach (APP)
- Crosstrack (XTK)

(2) APP

(a) A cyan APP indicates that the FMS is in the approach mode.

(3) XTK

(a) A cyan XTK message appears when the FMS has sent a crosstrack warning.

v Course Select/Desired Track Pointer

(1) The course/desired track pointer rotates with and about the center of the heading dial to supply a continuous indication of course error.

(2) When short range NAV is selected as the display source, the course pointer (green) is positioned on the rotating heading compass dial by a remote course select knob on the RI-553 remote instrument controller to select a magnetic bearing that coincides with the desired VOR radial or localizer course.

(3) When long range navigation is selected, the course pointer (magenta) becomes a desired track pointer. The position of the desired track pointer is controlled by the long range NAV system. A digital display of desired track (DTRK) is displayed in the upper left-hand corner. When FMS is selected, the course select data is supplied by the IC-615 IAC. If the FMS allows the pilot to manually set a track, the upper left-hand corner displays that digital set value.

w FMS Status Annunciators

(1) The FMS status messages that follow are annunciated to the left of the compass:

- Dead reckoning (DR)
- Degrade (DGR)
- Waypoint (WPT) alert
- GPS integrity (INTG).

(2) DR

(a) An amber DR indicates dead reckoning mode.

(3) DGR

(a) An amber DGR indicates a degrade mode of operation.

(4) WPT

(a) A lateral waypoint crossover is annunciated by an amber WPT. Sixty seconds prior to crossing an FMS waypoint, the amber WPT annunciator is displayed to the left of the heading compass. The annunciator flashes during this time.

(5) INTG

(a) An amber INTG indicates a failing GPS. The annunciator is removed when the selected NAV source is other than FMS.

(6) Message (MSG) is displayed to the right of the compass in amber to notify the pilot that an FMS message is present on the control display unit (CDU) (see Figure 2-1-28).

x Course Select/Desired Track Display

(1) The display for the current course select/desired track value appears in the upper left-hand corner of the HSI region (below the Mach display) as green, amber, or magenta digits. If SRN is selected as the navigational source, CRS is annunciated in white above the display. If LRN is selected as the navigational source, DTRK is annunciated (also in white) in place of CRS.

6 Partial Compass Format

a The partial compass format shown in Figure 2-1-29 displays the same information as the full compass format, except as identified in the paragraphs that follow.

(1) Only a 90-degree arc (±45 degrees) of the heading dial is visible in the partial compass mode. Pushing the HSI button once on the DC-550 display controller causes the heading dial to change to the partial compass format.

(2) The heading bug can be rotated off the compass scale. When the HDG bug is off scale, a cyan arrow is displayed on the outer compass ring to indicate the shortest direction to its location.

(3) A display of the aircraft's current heading is supplied above a V-shaped notch at the top (apex) of the partial compass. The V-shaped notch replaces the lubber line and fits inside the heading bug when the heading bug is positioned at the center of the arc.

(4) If the weather radar system is active, weather information is automatically displayed on the partial compass format.

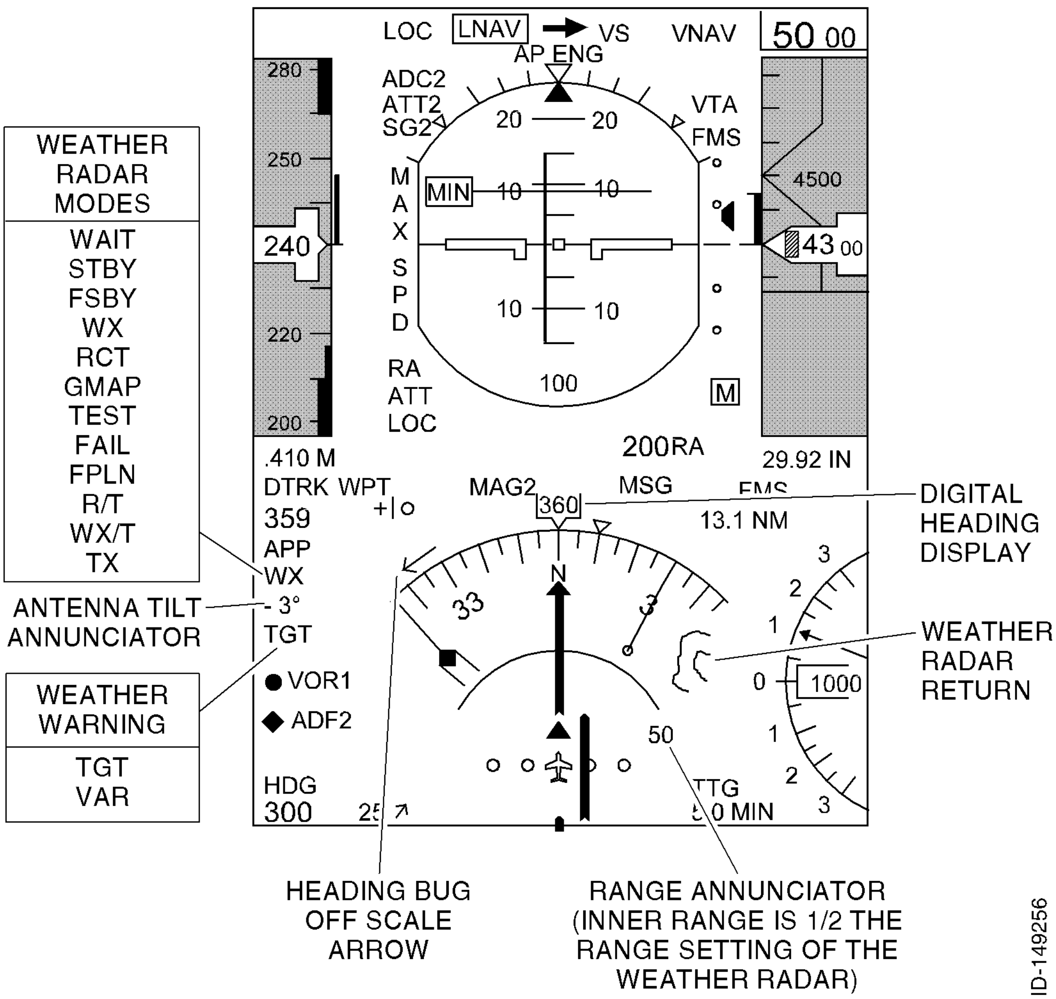


Figure 2-1-29. HSI Partial Compass Format

7 Weather Radar Display

a When selected by the DC-550 display controller, weather information is displayed on the partial compass format, as shown in Figure 2-1-29. Each PFD can display independently selected weather information.

b Weather Radar Mode Annunciators

(1) The WX mode annunciators, given in Table 2-1-27, are displayed to the left of the compass arc below the FMS approach mode annunciator field. Full WX modes are annunciated on the MFD. Mode annunciations are received over the serial interface from the RTA. When full compass format and WX are turned on, a magenta TX is displayed in the mode annunciator field.

(2) The RTA uses hardware and software monitors to detect and identify faults within the radar system. If WX fails, an amber FAIL message appears in the mode annunciation field. Faults are logged into nonvolatile memory by a unique fault code number. Readout of the fault memory contents can be obtained by setting the mode selection knob on the weather radar controller to TST (test). Fault codes are displayed in the antenna tilt angle field. If more than one code is associated with the failure, the numbers toggle between the different fault codes.

(3) Refer to the PRIMUS 440/660/880 Digital Weather Radar System Description and Installation manual, Pub. No. A09-3944-001, for specific information on fault code interpretation.

Table 2-1-27. Weather Annunciators

Annunciator	Mode Description	Color
WAIT	Power-up approximately one (1) minute	Green
STBY	Normal standby	Green
FSBY	Forced standby (WOW)	Green
WX	Normal weather	Green
WX	Invalid weather radar or invalid weather radar control bus	Amber
RCT	Normal weather with RCT	Green
GMAP	Ground map mode	Green
TEST	Test mode with no faults	Green
FAIL	Test mode with faults	Amber
FPLN	Flight plan mode	Green
R/T	Weather with RCT and turbulence detection	Green
WX/T	Normal weather with turbulence detection	Green
TX	Weather radar is transmitting but not selected for display and not in STBY, FSBY, WAIT, or FPLN	Green
NOTE: IF WX is not selected for display, but is active and valid and is in either the STBY, FPLN, FSBY, or WAIT modes, nothing is displayed.		

c Antenna Tilt Annunciator

(1) Above the target mode line is the antenna tilt angle display. The display range for tilt angle is -15 degrees to +15 degrees. Antenna tilt is displayed in 0.5 degree increments between -5 degrees and +5 degrees. For tilt angles greater than ±5 degrees, the resolution is in 1.0 degree increments. Tilt values are preceded by no sign (blank) for positive values and a minus sign (-) for negative values. A degree sign (°) appears after the tilt angle.

d Weather Warning Annunciators

(1) Directly below the WX mode annunciator line is a shared target alert (TGT) and variable gain (VAR) status line. The TGT annunciator warns of level 3 targets. A green TGT annunciator indicates an armed condition, while an amber TGT indicates a weather alert condition. If the RTA detects an alert condition, the TGT remains amber as long as the alert condition persists. An amber VAR annunciator in place of TGT shows the radar is operating in the variable gain mode. Target mode/alert has highest priority.

e Heading Bug Off Scale Arrow

(1) In the arc mode, the heading bug can be rotated off the compass scale. When the HDG bug is off scale, a cyan arrow is displayed on the outer compass ring to indicate the shortest direction to its location.

f Range Annunciator

(1) Range rings are shown to aid in the use of radar returns and position of navaids. The outer range ring is the compass card boundary and represents the selected range on the radar. The inner range ring is one half of the range setting (in nautical miles) on the weather radar controller. This range ring appears between the outer edge of the compass arc and the center of the aircraft symbol. Weather radar range is annunciated by white digits at the end of the half-range ring as shown in Figure 2-1-29. The radar range given in Table 2-1-28 is selected through the weather radar controller. If the radar range is turned off, by default the outer range ring represents 100 NM.

Table 2-1-28. Selectable Radar Ranges

Selected Range	Half Range Displayed
5	2.5
10	5.0
25	12.5
50	25.0
100	50.0
200	100.0
300	150.0
500*	250.0
1000*	500.0
NOTE: *Flight plan mode on weather radar controller selected.	

g Weather Radar Return

(1) Weather radar returns (picture data) appear within the compass arc. The returns are color coded, as shown in Table 2-1-29. The weather radar picture data is displayed in a 120-degree pattern if sector scan has not been selected on the weather radar controller. If sector scan is selected, a 60-degree pattern is displayed. A 60-degree sector scan is further identified by two white azimuth marks (not always shown) on the half range ring, at ±30 degrees of an imaginary line running through the center of the fixed aircraft symbol.

(2) The weather radar display is dimmed with the entire PFD. There is no dedicated weather radar dim control.

Table 2-1-29. Weather Radar Return Color Code

Return	WX Mode	GMAP Mode
Level 0	Black	Black
Level 1	Green	Cyan
Level 2	Amber	Amber
Level 3	Red	Magenta
Level 4	Magenta	NA
RCT	Cyan	NA
Turbulence	White	NA

h Digital Heading Display

(1) The aircraft's current heading is displayed above a V-shaped notch at the top (apex) of the partial compass. The V-shaped notch replaces the lubber line and fits inside the heading bug when the heading bug is positioned at the center of the arc.

(d) Airspeed Display

1 The airspeed display presents indicated, Mach, and maximum airspeed information. See Figure 2-1-30 for the location of annunciators described in the paragraphs that follow.

2 Flight Director Speed Target Display and Reference Bug

a The pilot-adjustable indicated airspeed IAS/Mach target is displayed inside a partial box above the airspeed tape. When the flight director SPD mode is engaged, the airspeed target is changed using the PC-400 autopilot controller PITCH wheel. The corresponding airspeed reference bug is shown on the right side of the airspeed tape. The airspeed digits and airspeed set bug are both cyan.

b When the flight director is not in the SPD mode, the flight director airspeed bug, airspeed target, and target box on that side are removed. If neither flight director is in the SPD mode, the airspeed target, partial box, and bug are removed from both pilots' displays. If the IAS/Mach target is set to a value outside the display range of the tape, the bug parks at the respective end of the tape, half visible and unfilled.

3 Vmo/Mmo Overspeed Indicator

a The Vmo/Mmo overspeed indicator is a fixed red bar located along the right-inside of the airspeed scale. The red bar originates at Vmo/Mmo and extends to larger airspeeds on the tape, until the end of the scale is reached.

4 Airspeed Trend Vector and Reference Line

a The airspeed trend vector appears as a magenta bar located along the outer right side of the airspeed tape. It is referenced to the airspeed reference line. The trend vector is a prediction of what the value of indicated airspeed (direction of acceleration) is in approximately 10 seconds, if the present trend is maintained. The trend vector extends vertically from the apex of the current airspeed value display window. The vector extends upward for positive acceleration, and downward for negative acceleration.

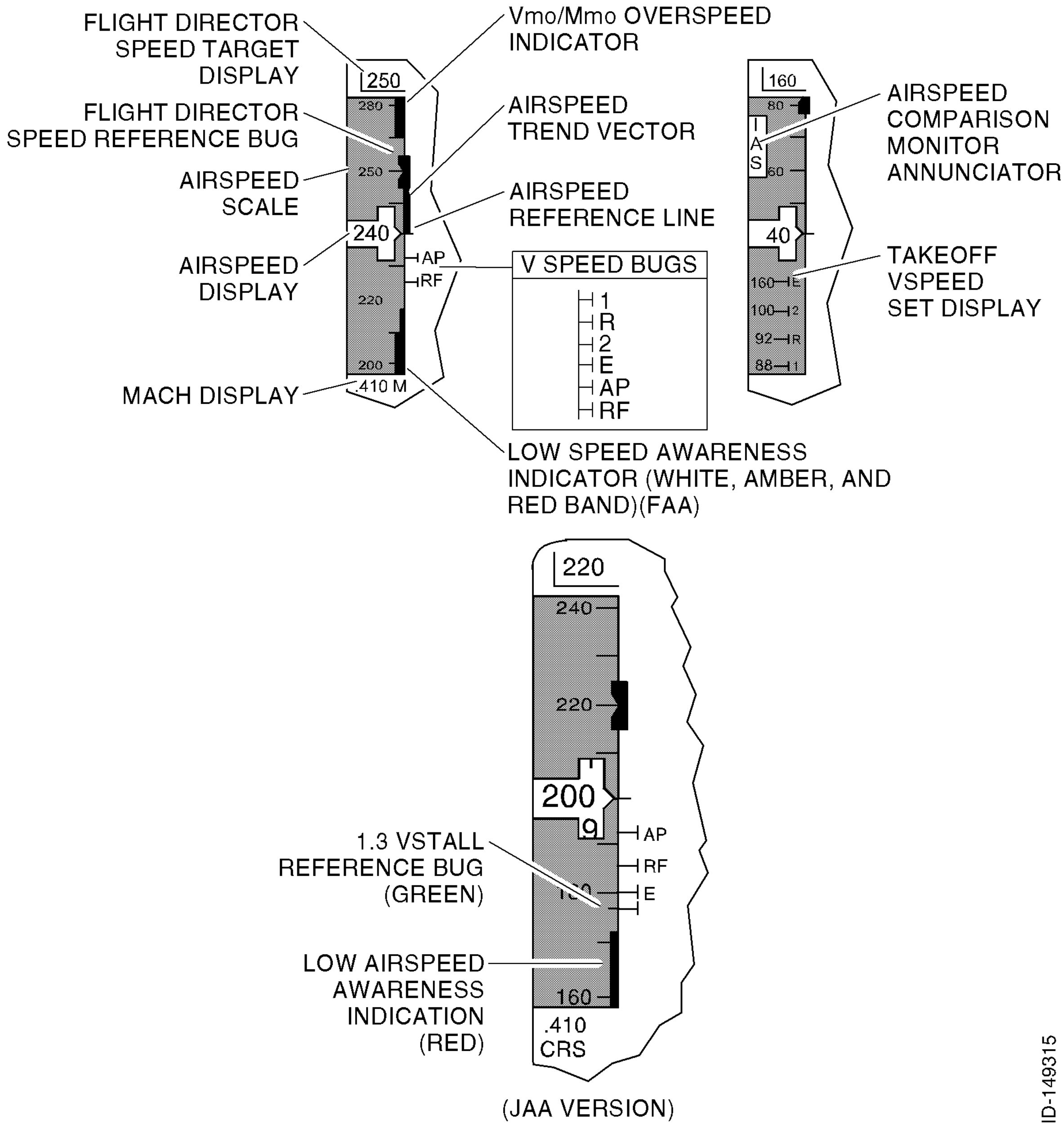


Figure 2-1-30. Airspeed Display

5 Vspeed Bugs

a In addition to the airspeed set bug previously described, Vspeed set bugs corresponding to speeds for various phases of flight are also displayed. This data comes from pilot inputs using the MFD T/O SPEEDS or LNDG menu. Six Vspeed set bugs (V1, VR, V2, Venr, Vapp, and Vref) are supplied. Each of the Vspeed set bugs has two elements, a label and horizontal T-shaped symbol. The airspeeds are labeled 1, R, 2, E, AP, and RF, and positioned on the right of the symbol. Assigned Vspeed labels and colors are described in Table 2-1-30.

Table 2-1-30. Vspeed Bug Parameters

Vspeed	Label	Speed Definition	Color
V1	1	Takeoff decision	Magenta
VR	R	Takeoff rotation	Cyan
V2	2	Takeoff safety	White
Venr	E	Single engine climb	Cyan
Vapp	AP	Approach	Magenta
Vref	RF	Landing configuration	Green

b The Vspeed set bugs travel up and down, along the outside right edge of the airspeed tape. Vspeed set bugs are removed after that speed has been attained and the airspeed deviates by ±50 knots. Vref and Vapp bugs are removed when power is turned off.

c When the aircraft speed is below 40 knots, V1, VR, V2, and VE are displayed in the bottom portion of the airspeed tape in the form of a digital readout. The digital readout of the set value is displayed along with the set bug symbol and label in ascending order, starting with V1. VE is automatically set to 160 knots (minimum value) and displayed when V1, VR, or V2 are set.

d Upon power up, the digital readouts for the set bugs are displayed as amber dashes. As the Vspeeds are set, the digital readouts follow the airspeed reference values entered through the MFD menu option. The digital readouts are removed from the PFD when the first Vspeed value appears on the airspeed tape.

e If either PFD is in the reversionary mode (i.e., displayed on the MFD), it is not possible to set Vspeeds.

6 Low Airspeed Awareness Indicator

a Indication of low airspeed is shown by a white, amber, and red tape located along the bottom right inside of the airspeed scale. The low airspeed awareness tape grows from the bottom up. The tape is white, amber, and red to note the aircraft condition relative to a stall.

b A white band extends from 1.3 Vstall to 1.2 Vstall, the amber band extends from 1.2 Vstall to stick shaker speed (1.1 Vstall), and the red band extends from stick shaker speed to smaller airspeeds on the tape. When the amber portion reaches the airspeed reference line, the aircraft is at approximately 0.7 AOA. When the red portion of the bar reaches the airspeed reference line (as calculated by an AOA input), the stick shaker activates.

7 Mach Display

a A digital read out of indicated Mach number is displayed below the airspeed tape. The range of the Mach number is 0.2 to 1. Resolution of the Mach display is 0.001 Mach. The color of the digits always agrees with the color of the digits on the airspeed display.

8 Airspeed Display

a A rolling digit display of the actual current IAS value is contained within a notched T-shaped box, centered on the airspeed scale. This data is a magnification of the digits on the scale and they are readable to within a 1 knot resolution. The rolling digits within the T-shaped box are green. When the current airspeed value is equal to or exceeds the maximum allowable airspeed (Vmo/Mmo), the digits turn red. When the airspeed trend vector exceeds Vmo by 1 knot, the rolling digits turn amber unless red is required.

b When an underspeed condition exists, the rolling digits also turn red. A MIN SPD message is displayed to the left of the ADI sphere when VNAV mode is engaged and the IAS drops below 160 knots. MAX SPD is displayed in place of MIN SPD anytime IAS exceeds Vmo/Mmo.

9 Airspeed Scale

a The airspeed scale is a moving vertical tape display with calibrated airspeed marks and a fixed pointer. The vertical tape is gray and the pointer is a notched T-shaped box with a rolling digital display inside. The vertical tape moves behind the pointer to indicate actual airspeed. Tick marks located along the right edge of the vertical tape are in 10-knot increments. Airspeed markings on the tape are labeled in 20-knot increments with larger numbers displayed at the top of the scale. Range of the airspeed scale is 40 to 400 knots. The T-shaped box pointer and the scale and its markings are white.

10 Airspeed Comparison Monitor Annunciator

a Activation of the airspeed comparison monitor is annunciated by an amber IAS in the upper end of the airspeed tape. The annunciator flashes for 10 seconds and then goes steady. The comparison monitor is activated by a difference of 5 knots of airspeed.

11 Takeoff Vspeed Set Display

a When less than 40 knots, V1, VR, V2 and VE are displayed in digital tabular form inside the lower portion of the airspeed tape. As the airspeed increases and the values come into view on the airspeed tape, the digital display is removed and subsequently replaced by the appropriate Vspeed bug.

12 1.3 V_{STALL} Reference Bug

a On the JAA version, the 1.3 V_{STALL} is indicated by a green bug on the airspeed tape.

13 Low Airspeed Awareness Indication (JAA version)

a A red underspeed bar is used to indicate the aircraft condition relative to a stall. It starts from the bottom of the right-hand side of the airspeed tape and stretches upward toward a < bug that represents 1.3 Vstall. The top of the bar represents 1.1 Vstall. The gap between the top of the red bar and the < bug remains constant. When AOA increases and the top of the red bar approaches the IAS window, the stick shaker is activated.

(e) Altitude Display

1 The altitude display presents current altitude, altitude preselect, barometric corrected altitude, altitude alert, and altitude trend vector information. See Figure 2-1-31 for the location of annunciators described in the paragraphs that follow.

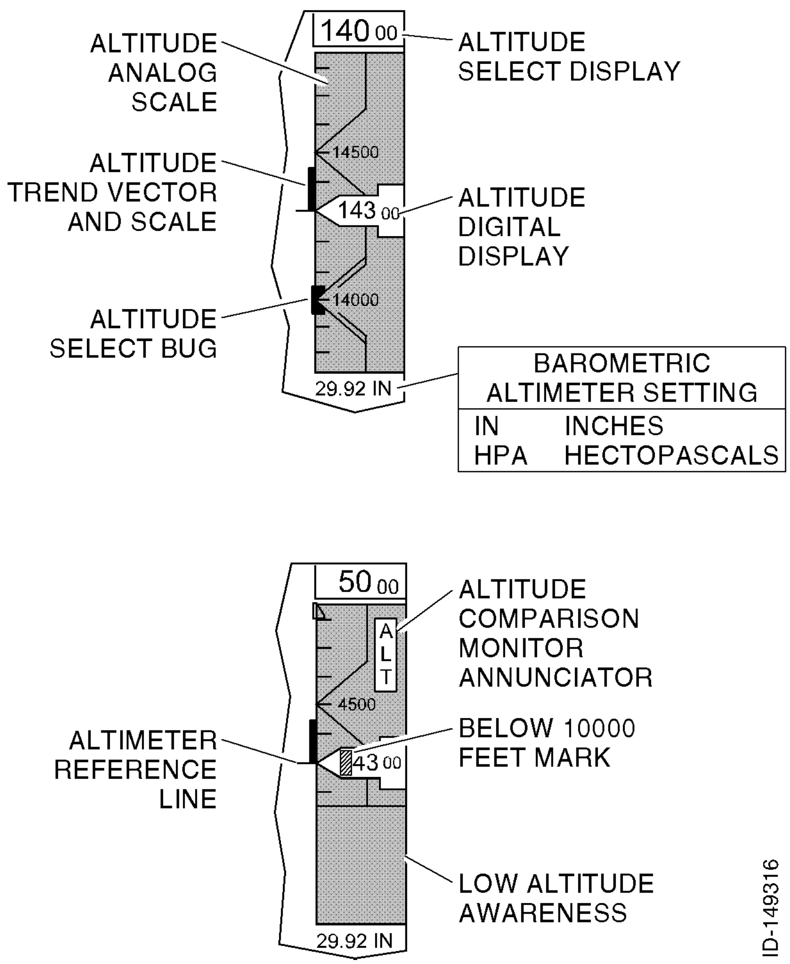


Figure 2-1-31. Altitude Display

2 Altitude Analog Scale

a The altitude tape is a moving scale with a fixed pointer. Tick marks are located along the left edge of the scale at 100-ft increments. The scale markings on the tape are labeled in 200-ft increments below 10,000 ft and in 500-ft increments above 10,000 ft. The altitude tape moves behind the fixed pointer window and displays a tape ±550 ft from the present altitude with the larger numbers at the top of the scale. The scale and its markings are white on a gray background.

b Altitude chevrons appear at each 500- and 1,000-ft mark below 10,000 ft to enhance the display. Single line chevrons are located at each 500-ft increment. Double line chevrons are located at each 1,000-ft increment. The chevrons extend back to the approximate midpoint of the altitude tape and are connected to each other with a vertical line.

c The chevron, altimeter reference line, and altitude select bug are designed to align when the selected and current altitudes are on 1,000- or 500-ft increments. When the selected altitude is a multiple of either 500 or 1,000 ft, the altitude select bug is shaped to fit the peak of the chevron shape and the digital altitude display window.

3 Altitude Select Display

a The preselected altitude is displayed above the altitude tape display with larger digits for hundreds, thousands, and ten thousands. The data originates from the selected MADC. Altitude preselect digits are cyan under normal circumstances. When a departure from the selected altitude occurs, the white box around the preselected altitude display and the digits turn amber to give an altitude alert.

b The altitude alert operating region is when the aircraft enters the region within 1,000 ft of the preselected altitude during a capture maneuver. At this point, the box around the set data turns amber. Once the aircraft is within 250 ft of the preselected altitude, the box turns back to white. After capture, the aircraft re-enters the altitude alert operating region if it departs more than 250 ft from the selected altitude. A momentary audio alert is also supplied when the aircraft is 1,000 ft from the preselected altitude or has departed 250 ft from the select altitude after capture.

c Display range of the altitude preselect window is -900 to 45,000 ft with a resolution of 100 ft. Power-up condition is with cyan dashes displayed. If the MADC is invalid, the preselect window displays amber dashes.

4 Altitude Digital Display

a Barometric altitude is displayed in a rolling digit window in the center of the altitude tape (fixed pointer). The left side of the rolling digit window is angled at the same slope as the chevrons. Display range of the altitude window is -1,000 to 60,000 ft. This data is a magnification of the digits on the scale and is readable to within a 20-ft resolution. The digits within the pointer are green with larger digits for hundreds, thousands, and ten thousands.

b For climb/descent rates greater than 1,000 ft/min, the rolling drum digits are replaced by two dashes to enhance altitude scale readability. Below 10,000 ft, a boxed cross-hatch replaces the ten thousands digit to enhance low altitude awareness.

5 Barometric Altimeter Setting

a The baro set window is located directly below the altitude tape. The pilot can set the altimeter in either inches of mercury (inHg) or hectopascals (hPa), as selected with the display controller. If the onside display controller is invalid, the SG defaults to the last selection (IN or HPA). The baro set data is always cyan.

b The set range for inches of mercury is 0.00 to 79.99, ±0.01 inHg; and for hectopascals 0 to 7999, ±1 hPa.

6 Altitude Select Bug

a A moving altitude bug is displayed along the left side of the altitude tape across from the value set in the altitude select display. The altitude select bug is notched to fit the 1,000- or 500-ft altitude tape chevron format. If the selected altitude value is not within the displayed range, the bug is parked at the top or bottom left edge of the vertical tape, and represents one half of the select bug (unfilled). The bug color tracks the digit color in the altitude select window. If the bug is moved off the current scale range, half of the bug remains on the scale to indicate the direction to the set bug.

7 Altitude Trend Vector and Scale

a The trend vector is a thin, magenta, thermometer-shaped bar that corresponds to altitude rate. The altitude trend vector originates at the altitude reference line and moves along the left side of the altitude tape. The altitude trend vector predicts actual aircraft altitude in 6 seconds if the same vertical speed is maintained. The trend vector scale is calibrated in 1,000-ft tick marks from the altitude reference line. Altitude rate is output from the MADC.

8 Altitude Comparison Monitor Annunciator

a Activation of the altitude comparison monitor is annunciated by an amber ALT in the upper end of the altitude tape. The annunciation flashes for 10 seconds and then goes steady. The comparison monitor is activated by a difference of 200 ft of altitude or greater.

9 Low Altitude Awareness

a At radio altitudes of 550 ft or less, the lower part of the altitude tape linearly changes from a gray raster to brown and the altimeter scale markings are removed. At zero radio altitude, the brown raster touches the altimeter reference line.

10 Altimeter Reference Line

a The altimeter reference line is at the center of the altimeter rolling digits display. The reference line is the only reference point for the altitude trend vector. When the trend vector rises above the reference line, a climb is indicated. When it falls below the line, descent is indicated.

(f) Vertical Speed Display

1 The vertical speed display presents the absolute value for rate of climb or rate of descent on a scale centered around zero vertical speed. If the aircraft is equipped with TCAS, the vertical speed display also presents traffic information and warning advisories. See Figure 2-1-32 for the location of displays described in the paragraphs that follow.

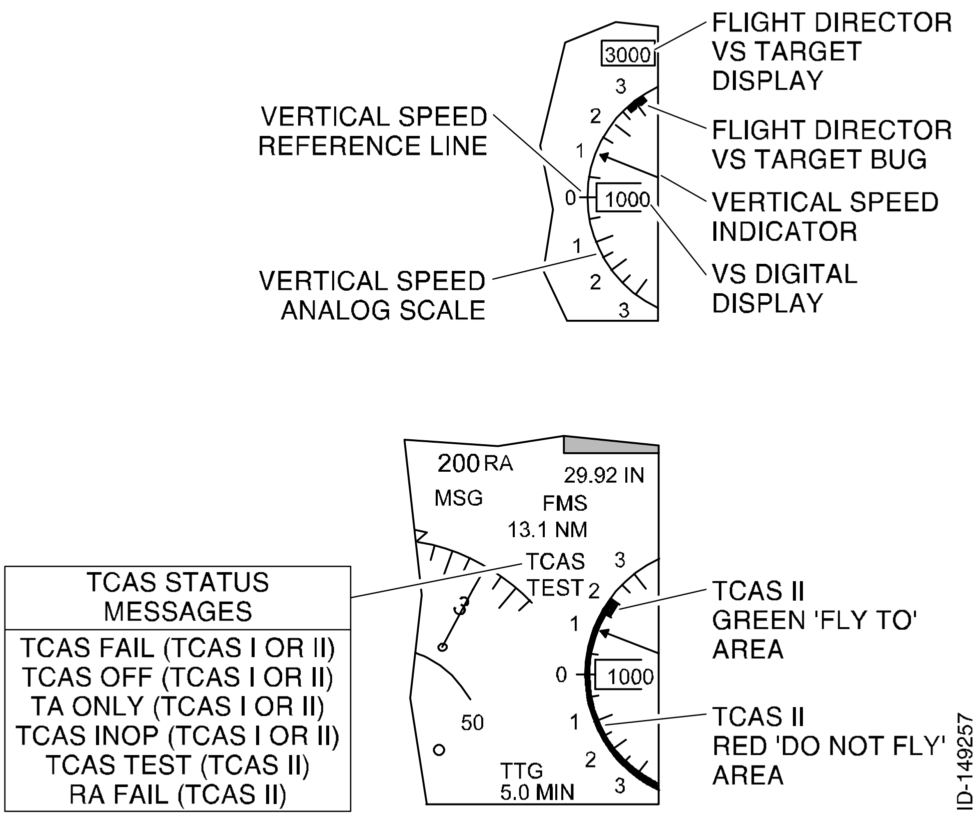


Figure 2-1-32. Vertical Speed Display

2 VS Target Display

a The pilot-adjustable VS target is displayed inside a white box above the VS analog scale. The VS target display range is from -9,999 to +9,999 ft/min and display resolution is 100 ft/min. When the VS mode is engaged from either flight director, the vertical speed target is changed using the PC-400 autopilot controller pitch wheel. The corresponding vertical speed set bug is shown on the inside arc of the vertical speed scale. Digits for the VS target display and the bug are both cyan. If neither flight director is in the VS mode, the vertical speed target, box, and bug are removed from both pilots' displays.

3 VS Set Bug

a Engaging the vertical speed mode brings the VS set bug into view. The VS set bug travels along the inside of the VS scale. The bug lines up with the value on the VS scale that is set with the PC-400 autopilot controller. The bug is always cyan.

4 VS Indicator

a The VS arrow points to the numerical readout on the vertical speed analog scale, which corresponds to the digital readout in the VS digital display.

5 VS Digital Display

a A digital display of actual vertical speed is located in a white partial box centered within the scale, at the zero reference line. This data is a magnification of the digits on the scale and is readable to within a 50 ft/min resolution. Maximum value is 9,900 ft/min. For values between ±500 ft/min, the digital display and its box are removed. At values beyond ±500 ft/min, the digital value of vertical speed is displayed. The digits within the box are normally green and only turn red to indicate an alert.

6 VS Analog Scale

a The VS scale is a fixed meter type display, with a moving pointer that rotates about a point outside of the actual display. The scale is a 134-degree arc with tick marks incremented at 500 ft/min intervals. Large tick marks are displayed at ±1,000, ±2,000, and ±3,000, and small tick marks are displayed at ±500, ±1,500, and ±2,500 ft/min. Scale markings are labeled outside the arc at 0, ±1, ±2, and ±3 to indicate thousands of feet per minute. The scale and its markings are white.

b Pointer deflection range is from -3,500 to +3,500 ft/min. For vertical speeds greater than ±3,500 ft/min, the pointer continues to move up to ±6,600 ft/min, but at a reduced sensitivity. The digital display shows the actual vertical speed value. Also, the pivot point of the pointer adjusts so that most of it remains in view as the pointer moves up the scale.

c The pointer parks at the end of the scale for values greater than ±6,600 ft/min. The digital display is removed for vertical speeds between -500 and +500 ft/min. Pointer movement is nonlinear between -1,000 and +1,000 ft/min to give greater resolution of the vertical speed. Pointer color is normally green and only turns red to indicate an alert.

7 VS Reference Line

a This line represents straight and level flight or vertical speed zero. When the aircraft is in straight and level flight, the vertical speed digital display is removed and the vertical speed indicator points to the reference line (0 ft/min).

8 TCAS Resolution Advisory Display (Option)

a The VS display also presents a green fly-to target and a red do-not-fly band on the VS scale, which commands the pilot to comply with a TCAS resolution advisory to avoid a potential aircraft conflict.

b A resolution advisory is a display indication given to the pilot recommending a maneuver to increase vertical separation relative to an intruding aircraft. There are two types of resolution advisories: corrective and preventive. A corrective resolution advisory instructs the pilot to deviate from current vertical speed to avoid the intruder. A preventive resolution advisory instructs the pilot to avoid certain deviations from the current vertical speed.

c For each type of resolution advisory, there is a red band on the inside edge of the vertical speed scale for forbidden vertical speeds. The digital VS display and the pointer on the scale are red when vertical speed falls within the forbidden zone. For a corrective resolution advisory, a specific green fly-to band attached to the red band is displayed. The nominal length of the green band is the length between the 1,500 and 2,000 ft/min tick marks. The green band is twice the width of the red band.

9 TCAS Status Messages

a The TCAS status messages are presented to the left of the vertical speed display. When a TCAS resolution advisory is displayed, the vertical speed digital display notches the color of the red or green band where the pointer is located. Table 2-1-31 gives the TCAS messages annunciated on the PFD.

Table 2-1-31. TCAS Status Messages (PFD)

Message	Color	Description
TCAS FAIL	Amber	TCAS failure
TCAS OFF	White	TCAS is off
TA ONLY	White	Traffic alert on
TCAS INOP	White	TCAS inoperative
TCAS TEST	White	Power-up test in progress
RA FAIL	Amber	Radio/altimeter failure

(g) Excessive Attitude Declutter

1 The display is decluttered when an unusual attitude condition is displayed. The condition is defined as follows:

- Bank greater than ±65 degrees
- Pitch greater than 30 degrees up
- Pitch greater than 20 degrees down.

2 The following items are removed from the display when the above logic has been satisfied:

- Vertical, lateral, and nonsynched flight director mode annunciators
- Vertical and lateral LRN submode annunciators
- Flight director couple arrow
- EGPWS mode annunciators (if applicable)
- Low bank limit arc
- Flight director command bars
- Vertical deviation scale, pointer, and label
- Vertical track alert annunciation
- Marker beacons and box
- Radio altitude digital readout and stroke mask
- Radio altitude minimums digital readout and label
- Selected airspeed bug digital readout and outline
- Selected altitude bug digital readout and outline
- All failure flags for the items listed above
- Comparison monitors annunciators as follows:
  - Heading
  - Radio altitude
  - Localizer
  - Glideslope
  - ILS.
- Lateral mode transition box
- Minimum altitude annunciator and box.

(h) PFD Test

1 The PFD test can be initiated by pushing and holding the TEST button on the DC-550 display controller when airspeed is valid and less than 60 knots, and the WOW switch is in the on-ground mode. Failure mode indications occur for the first 5 to 6 seconds after the TEST button is pushed. The following formats are displayed for this 5- to 6-second period, as shown in Figure 2-1-33 and Figure 2-1-34:

- Course select, heading select, DME, vertical speed set command, airspeed command, altitude preselect, Mach, baro correction, and GSPD/TTG digital displays are replaced by amber dashes.
- ATT and HDG displays are flagged: ATT FAIL, HDG FAIL
- Vertical deviation, course deviation, airspeed and altitude scales are flagged with a red **X.**
- Flight director command bars go out of view and mode annunciators are removed from PFD.
- Radio altimeter digital readout displays radio altimeter self-test value, if radio altimeter supports self-test feature; slews to 100 ft for Honeywell radio altimeter.
- Comparison monitor annunciates ATT, HDG, ILS, and RA.
- Magenta TEST is annunciated on the PFD.
- Compass sync is removed from display.
- All bugs and pointers are removed from display.

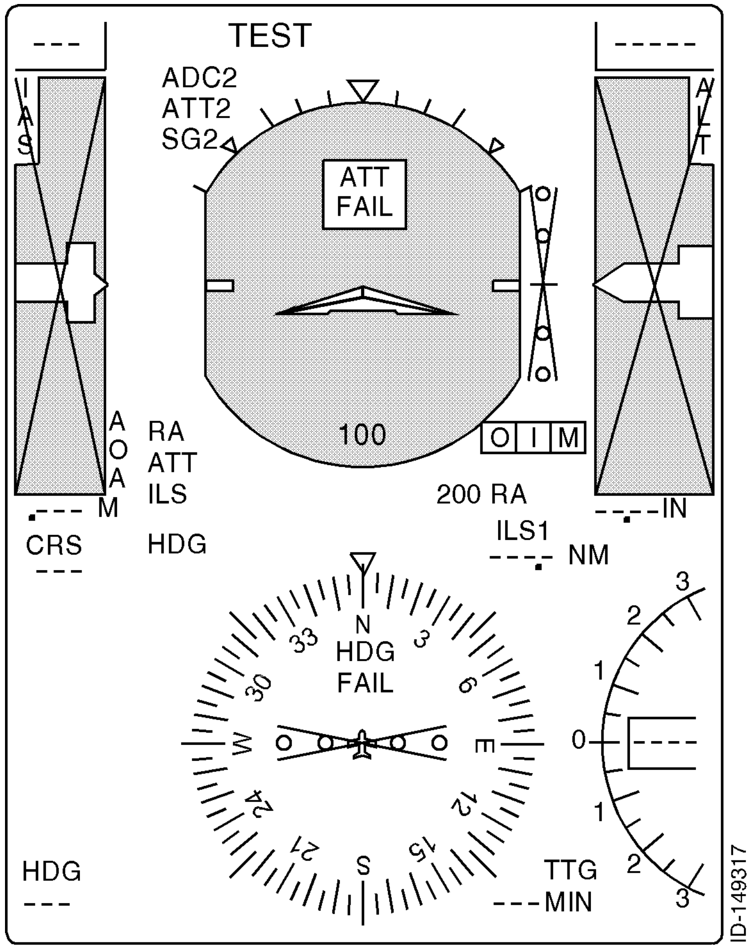


Figure 2-1-33. Full Test Mode With Failure Flags

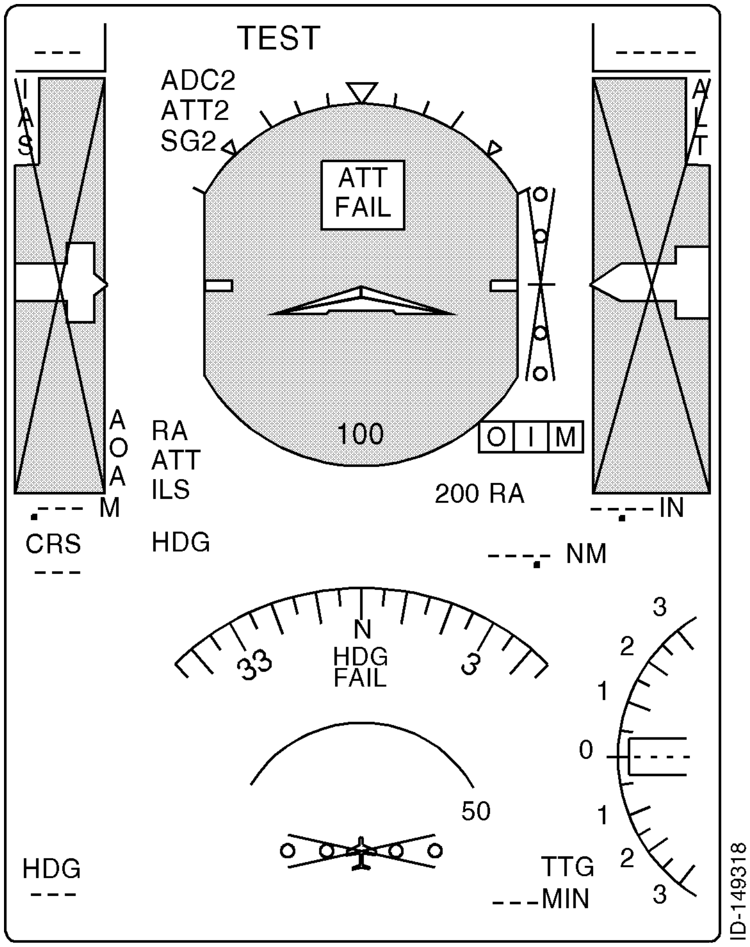


Figure 2-1-34. Arc Test Mode With Failure Flags

(i) PFD Failure Flags and Annunciators

1 The PFD failure flags and annunciators are shown in Figure 2-1-35. Refer to this figure for the location of the caution and failure annunciators that follow.

2 Symbol Generator Reversion Annunciator

a When selected on the MC-800 MFD controller, and if the MC-800 control bus is valid, SG reversion is annunciated on the upper left side of the attitude sphere of all PFD formats.

b An amber SG1 is annunciated on all PFD formats when SG reversion of the left IC-615 IAC is selected. When in SG1 reversion, the IC-615 IAC No. 1 drives both PFDs and the MFD. The No. 2 PFD is a duplicate of the No.1 PFD.

c Similarly, SG reversion of the right IC-615 IAC is annunciated as an amber SG2 on all PFD formats. When in SG2 reversion, the IC-615 IAC No. 2 drives both PFDs and the MFD. The No. 1 PFD is a duplicate of the No. 2 PFD.

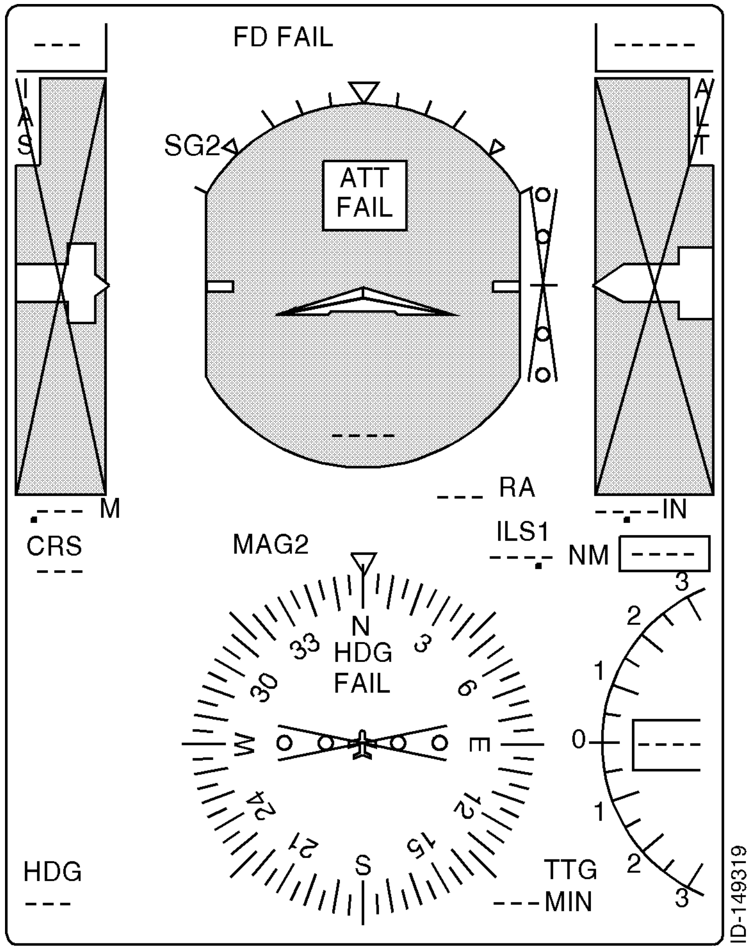


Figure 2-1-35. PFD Failure Flags and Annunciators

3 Attitude Reference Failure

a Loss of valid attitude data in either pitch or roll, from the active attitude source, is indicated by the following:

- The pitch scale and roll pointer is removed.
- The entire attitude sphere is painted a solid cyan.
- A red ATT FAIL is displayed in the top center of the attitude sphere.
- The aircraft symbol remains on the display.

4 Flight Director Failure

a Loss of valid FD data from the master IAC causes the following indications:

- An amber FD FAIL warning is displayed at the top-left of the ADI.
- Flight director cue and all FD mode annunciators are removed.

5 Pointer/Scale Failures

a Vertical deviation, altitude scale, airspeed scale, and vertical speed scale are displayed by means of pointer/scale displays. Loss of a valid or detection of a related I/O failure causes the pointer/scale displays to show a failure by the following:

- Removing the pointer (GS and VS only)
- Replacing the digital readouts with amber dashes
- Drawing a red **X** through the scale (IAS, ALT, and GS only).

6 Radio Altitude Failure

a In the event of a radio altimeter failure (loss of the RA valid or loss of a related I/O), amber dashes replace the radio altitude digits.

7 Distance

a Loss of the SRN DME valid or the FMS distance valid causes the distance digits to be replaced by amber dashes.

8 Mach Number Failure

a Amber dashes are displayed in place of the Mach number digits when the selected air data fails (loss of the air data valid or loss of a related I/O).

9 Baro Correction Failure

a Baro correction digits are replaced by amber dashes when the source of air data fails (loss of the air data valid or loss of a related I/O).

10 GSPD/TTG

a Loss of SRN DME valid or FMS distance valid causes the ground speed/time-to-go digits to be replaced by amber dashes.

11 Heading Failure Display

a Loss of the heading valid or the detection of a related I/O failure causes the following:

- Digital heading bug is removed and a red HDG FAIL is displayed.
- The bearing pointers, wind vector, map display, to/from, selected HDG bug, drift angle, selected CRS/DTRK, and CRS DEV are removed.
- Heading source annunciator is DG 1-2 or MAG 1-2.
- HDG select and CRS select/DTRK digital display is replaced by amber dashes.

12 Course Deviation Failure

a An invalid or failure of the course deviation data (loss of the NAV valid or loss of a related I/O) is shown by removing the deviation bar and displaying a red **X** through the scale deviation dots.

13 Course Select Failure

a Failure of the course select signals causes the display to be replaced by amber dashes and the course pointer to be removed from the display. This indication also is given in the event of an invalid heading display or FMS source.

D. MFD

(1) The MFD is primarily used for lateral representation of the aircraft's flightpath. The MFD is also used to display various system checklist pages, as required by the flightcrew. In general, control of the MFD is through the MC-800 MFD controller.

(a) MFD Functional Divisions

1 The MFD is divided into four functional display areas, as shown in Figure 2-1-36: plan or map display, lower left and lower right window displays, and TCAS or checklist window. Certain symbols are available with any display format. Some symbols are only available with specific display formats. The lower portion of the MFD is always reserved for the display menu window.

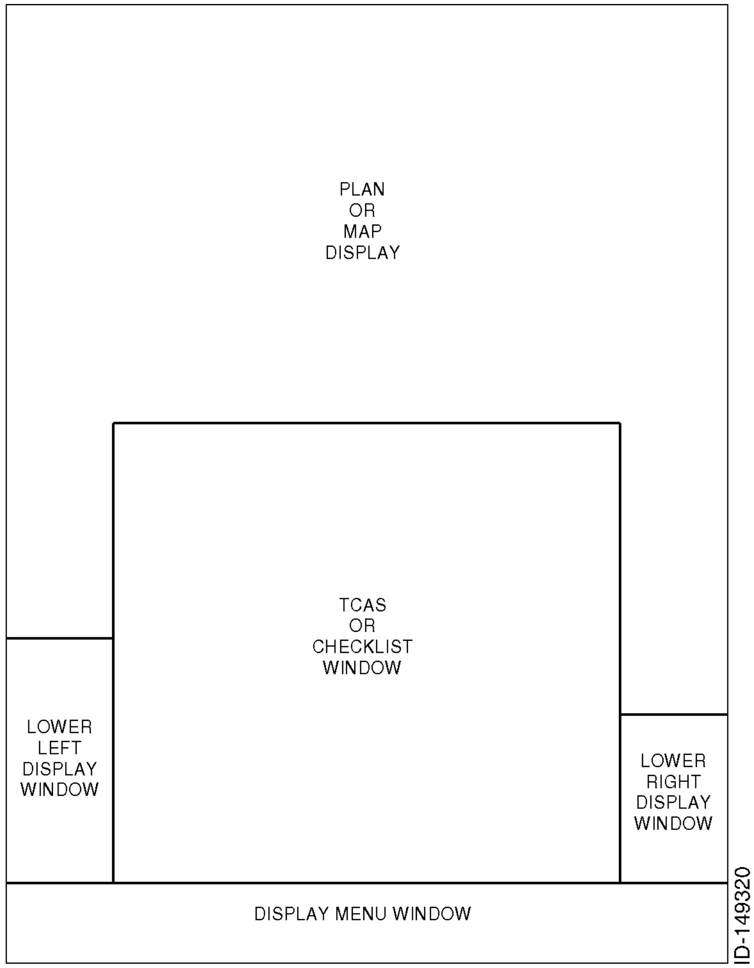


Figure 2-1-36. MFD Functional Divisions

2 Plan or Map Display

a The MFD flightpath display can be presented in two basic formats: a partial arc (map) and a plan mode. The primary difference is the base reference or home position (the aircraft symbol) and display of current heading. In the map display, the aircraft current position is fixed at the apex of a 120-degree sector with current heading up. In the plan format, the home position is at the center of the display with true north up. The plan format encompasses 360 degrees. Checklists and TCAS resolution advisories are displayed in either the map or plan formats. Weather information is displayed in the map format only.

b When checklists or TCAS display functions are selected, a display window is presented in the bottom portion of the MFD between the lower left and right windows. The MFD's map or plan navigation displays are slightly repositioned toward the top of the MFD.

c Display formats are selected through the MC-800 MFD controller. Actual aircraft heading information is supplied by the selected heading source, while waypoints, airport, and navaid information is from the FMS.

d When checklist or TCAS is displayed, a portion of the MFD's map or plan mode may be removed to give more space.

3 Lower Left Display Window

a Weather radar status and mode information is displayed in the lower left window when the selected lateral navigation display format is map. Basic weather mode annunciators are displayed on line 1 (top). REACT submodes are displayed on line 2. Antenna tilt information is displayed on line 3, while various status indicators are displayed on lines 4 and 5.

b Target alerts and variable gain annunciators are displayed regardless of the selected navigation display format.

4 Lower Right Display Window

a TAS and GSPD information is always displayed in the lower right window, regardless of the selected lateral display format.

5 Display Menu Window

a The majority of the display control functions are handled by the menus presented in this window. There is a top-level main menu and three submenus. These menus allow selection and setting of altitude select, vertical speeds, and control of the vertical navigation function. The submenu pages are made up of a VNAV parameter set page, a takeoff speed set page, and a landing speed set page. The menus are organized to supply immediate access to and control of the required display control functions with a minimum of menu depth. Refer to paragraph 2.C. for a description of the display controller.

(b) MFD Map Mode Display

1 The map (partial arc) format, as shown in Figure 2-1-37, supplies a large horizontal situation presentation using almost the entire DU-1080 display area. This presentation places the aircraft position near the center of the display. Power-up condition is with the map format displayed. In addition to the symbols described under MFD common symbols, this paragraph details the unique map display data.

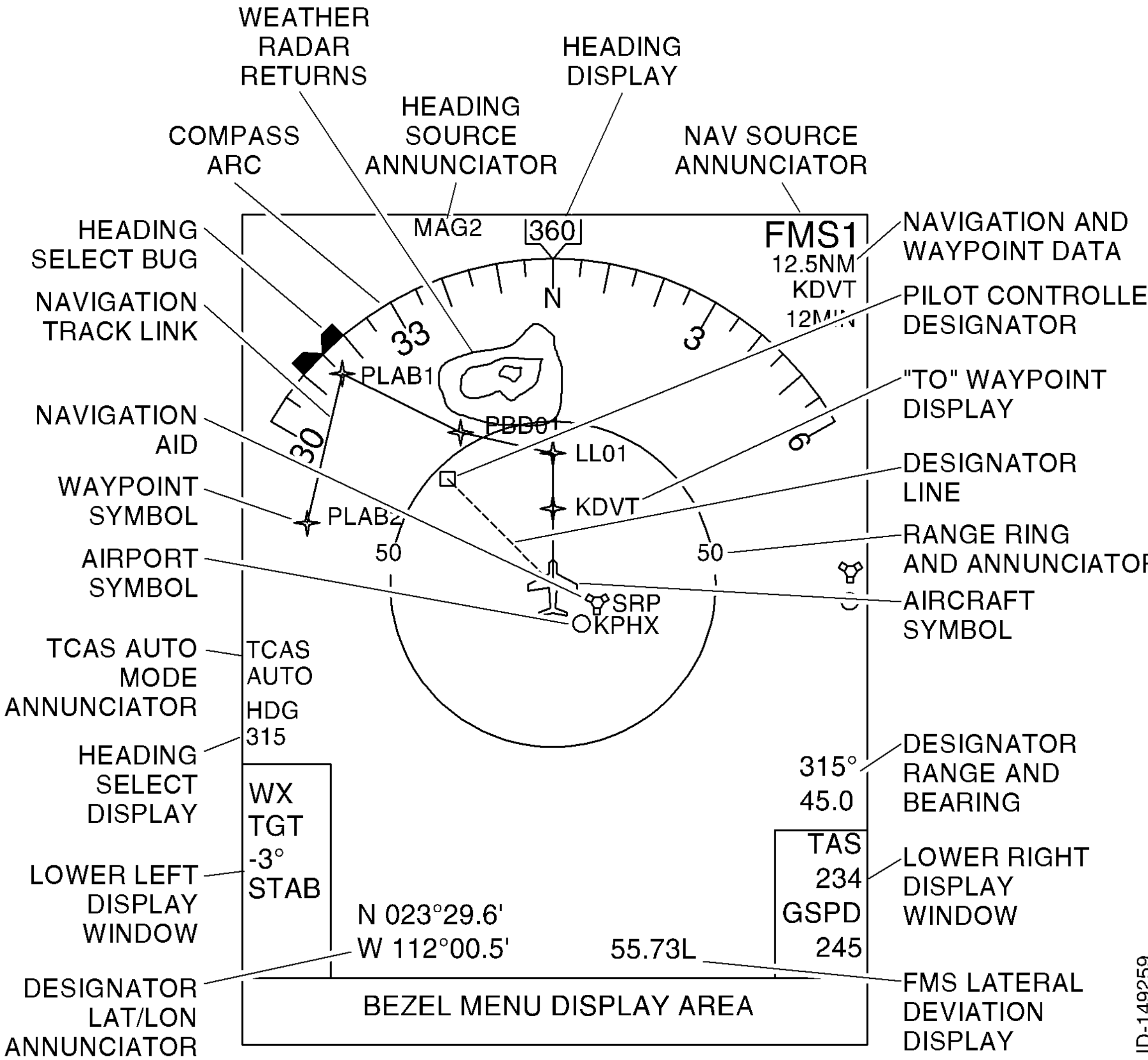


Figure 2-1-37. MFD Map Display

2 Navigation and Waypoint Data

a The upper right corner of the display shows the navigation and waypoint data. This data includes a navigation source annunciator, a TO waypoint distance, station identifier, and TTG.

b Navigation Source Annunciator

(1) The LRN source is the FMS. The navigation source is annunciated in the upper right corner of the display area. FMS is displayed full time in magenta for lateral deviation, even if the FMS data is invalid.

c TO Waypoint Display

(1) A TO waypoint designates the next waypoint on the flight plan. The distance, identifier (IDENT), and TTG associated with the TO waypoint are displayed below the navigation source annunciation.

(2) The EDS receives distance information from the onside and cross-side navigation receivers and the FMS. The distance digits for the TO waypoint are magenta with a white NM label annunciator. Invalid distance is annunciated with amber dashes in place of the digits.

(3) The waypoint identifier (IDENT) associated with the TO waypoint is displayed in magenta below the waypoint distance readout. An IDENT is mnemonic text placed adjacent to a navaid, APT, or WPT symbol. The color of the text corresponds to the navaid, APT, or WPT symbol with which it is associated. The FMS waypoint IDENT flashes when a WPT ALERT condition is transmitted by the FMS. The IDENT is removed from the display if invalid.

(4) The flight time remaining TO the waypoint is displayed below the IDENT in minutes. The flight TTG digits and label are white. Invalid TTG is annunciated with amber dashes in place of the digits.

3 Aircraft Symbol

a The white aircraft symbol gives a visual cue to aircraft position relative to actual and selected headings.

4 Lower Right Display Window

a The lower right window displays TAS and GSPD data.

(1) TAS is displayed with a resolution of 1 knot in the lower right window. This data originates from the MADC, as selected on the onside PFD. The digits are green and the TAS label is white. If TAS is invalid, amber dashes are displayed in place of the digits.

(2) GSPD information is displayed (in knots with leading zeros suppressed) directly below the TAS readout. This information is received from the FMS via ARINC 429 bus. The MFD NAV source is always FMS for the map and plan formats. For valid GSPD data, the label is white and the digits are green. Invalid GSPD is annunciated with amber dashes in place of the digits when the ARINC bus fails, or when a message identifying groundspeed as invalid is received.

5 FMS Lateral Deviation Display

a Crosstrack distance information is displayed on the MFD with L or R digits when the path is left or right of desired track. Distance is displayed with values from 0 to 128 NM with a 0.01 NM resolution for distances less than 100 NM and 1 NM for distances over 100 NM.

6 TCAS AUTO Mode Annunciator

a TCAS AUTO is annunciated in white above the heading select display, when the automatic pop-up mode is enabled through a TCAS control head.

7 Heading Select Display

a A digital readout (cyan) of the heading bug's current selected value is displayed above the lower left display window. The selected heading is annunciated with a white HDG label above it. Deviation between the heading display and bug, as read against the heading scale, is limited to ± 1 degree.

8 Lower Left Display Window

a The weather radar TGT and VAR annunciators are displayed in the lower left window. The remaining portions of the lower left window are unique to the map format with weather radar selected.

b WX TGT Annunciator

(1) The TGT annunciator warns of level 3 targets. A green TGT annunciator indicates an armed condition, while an amber TGT indicates a weather alert condition. If the RTA detects an alert condition, the TGT remains amber as long as the alert condition persists.

c VAR Annunciator

(1) An amber VAR annunciation in place of TGT shows the radar is operating in the variable gain mode. Target mode/alert has highest priority.

9 Flight Plan Data

a Various map symbols are on the MFD map display. FMS-supplied map waypoints, airports, and various VOR, VOR/DME, or DME-only navigation aids data are each represented using unique symbols. If available, pilot-defined holding patterns and top of climb/top of descent (TOC/TOD) symbols are a function of the installed FMS.

b Designator LAT/LON Annunciator

(1) The latitude (LAT) and longitude (LON) of the designator is displayed on the bottom middle-left portion of the MFD in cyan with a resolution of 0.1 minutes. Leading zeros are not suppressed.

c Designator Range and Bearing

(1) Using the joystick and SKP/RCL function on the MC-800 MFD controller, the pilot can position the square map designator (cursor). Distance and bearing location of the designator, relative to its reference point, is shown above the GSPD/TAS window. The color of the designator distance/bearing readout is always cyan.

(2) The range is displayed with a resolution of 0.1 NM below 400 NM. For distances equal to or greater than 400 NM, range resolution is 1 NM. The bearing is drawn with a resolution of 1 degree.

d Airport Symbol

(1) The airport symbol is a circle that represents the location of an airport referenced to the present position. The airport symbol is drawn in cyan, and the maximum number displayed at any given time is limited to four. If airports are selected for display, a cyan circle is displayed at the right center of the MFD.

e Waypoint Symbol

(1) A waypoint symbol is a four-pointed star, positioned at the LAT and LON of geographical locations, referenced to the current present position, where selected transitions of the flight plan occur. All waypoints except the TO waypoint are drawn in white. The TO waypoint is drawn in magenta. A maximum of 10 connected waypoints are displayed. A navaid or airport may also be located on the flight plan at a transition point and is included as a waypoint in the maximum number of allowed waypoints. Waypoint lines are white lines connecting waypoints in the sequence established by the LRN source.

f Range Ring and Annunciator

(1) Range rings are positioned at a constant radius from the home position. The range rings are drawn in white. Range annunciators are also displayed in white and positioned adjacent to the range ring, giving the range in nautical miles from the home position to the range ring.

g Designator Line

(1) The designator line is drawn in dashed cyan from the designator position to the selected waypoint.

h Navigation Aid

(1) The navigation aid symbol (VOR, DME, collocated DME/VOR) is a triangular arrangement of unfilled rectangles that represents the position relative to the present position. Navigation aids are drawn in green. A maximum of four disconnected navigation aids are displayed. If navigation aids are selected for display, a green triangular arrangement is displayed at the right center of the MFD.

i Navigation Track Line

(1) The navigation track line begins at the aircraft symbol and connects all the waypoints on the display that are in the flight plan. The track line shows the pilot the flight plan in a map format.

j Pilot Controlled Designator

(1) The designator is displayed as a cyan, square-shaped symbol connected to the reference point by a cyan dashed line, when offset. The designator is used to designate a position on the map that can be sent to the FMS in the form of distance and bearing from the reference waypoint.

(2) The designator is applied in two distinct methods. In method one, the designator is collocated with a waypoint. In method two, the designator is positioned with a joystick. When collocated with a connected waypoint, the designator is displayed in the color of the waypoint. If the designator is moved off a connected waypoint, it is displayed in cyan. When the designator is parked at its home position (the aircraft symbol), it is not displayed. Power-up condition is with the designator co-located on the present position.

10 Heading Select Bug

a A cyan heading select bug is displayed on the compass arc. Its position follows the pilot's PFD heading select bug. The heading select bug can be rotated off the compass scale when in the map mode. When the heading select bug is off scale, a cyan arrow is displayed on the outside of the partial compass arc to indicate the shortest direction to the heading select bug.

11 Compass Arc

a Gyro-stabilized magnetic compass information is displayed by a 120-degree compass arc. The arc rotates about the stationary aircraft symbol (throughout 360 degrees of motion) to continuously supply 120 degrees of heading information. Actual (current) heading is displayed in a digital readout located above the partial compass arc.

b The arc (scale) is composed of long and short tick marks that alternate every 5 degrees. Digits and cardinal abbreviations are spaced in 30-degree increments around the inside of the arc. Numeric identifiers are present at 30, 60, 120, 150, 210, 240, 300, and 330 degrees. These digits represent tens and hundreds of degrees at their respective locations.

12 Heading Source Annunciator

a The heading source for this display is the same heading source that drives the onside PFD. Heading source is annunciated directly to the left of the digital heading display. Cross-side data is displayed in amber as DG or MAG with the side designator 1 or 2 as appropriate. When the pilot and copilot sources are the same, they are annunciated on all displays in amber. For onside DG or MAG data, no source annunciator is given.

13 Heading Display

a A digital readout of the current heading is displayed within an open pointer box positioned above the partial compass arc. The box and current heading values are shown in white.

(c) Map Mode With Weather Display

1 Weather information from the radar is displayed on the map format, as shown in Figure 2-1-38, only when the radar controller has been turned on and weather has been selected for display with the MC-800 MFD controller. The weather radar modes are annunciated in the lower left display window. The weather radar annunciations on the MFD are the same as the PFD, except there are four lines (fields) of mode annunciators, as opposed to three on the PFD. (Line 1 is at the top of the window and line 4 is at the bottom.)

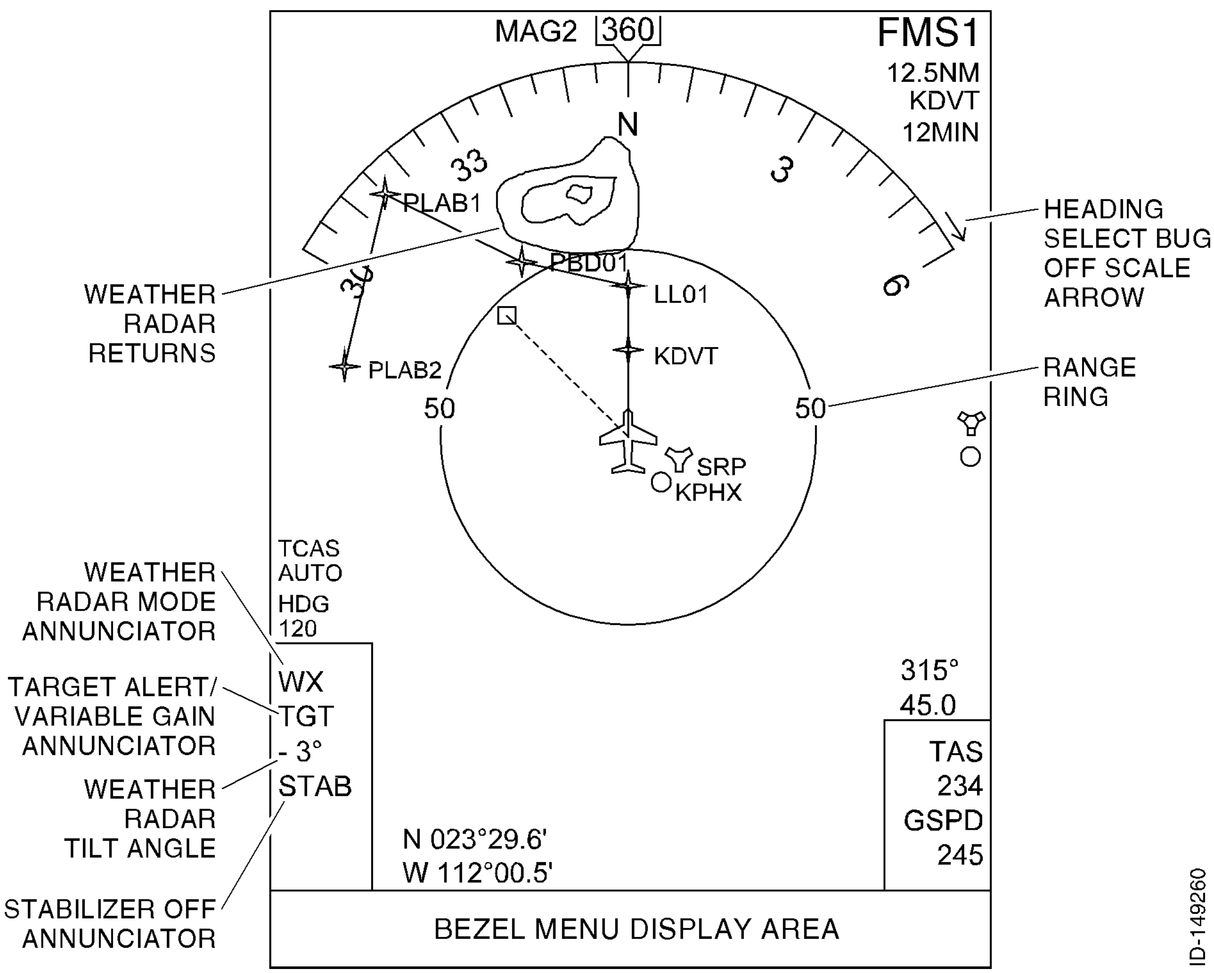


Figure 2-1-38. MFD Map Mode With Weather Display

2 Heading Select Bug Off Scale Arrow

a The heading select bug can be rotated off the compass scale when in the map mode. When the heading select bug is off scale, a cyan arrow is displayed on the outside of the partial compass arc to indicate the shortest direction to the heading select bug.

3 Range Ring

a Range rings are displayed to aid in determining the position of radar returns and active flight plan parameters. The range ring boundary is the compass card arc. The inner range ring is one half of the range setting (in nautical miles) on the MC-800 MFD controller. This range ring appears between the outer edge of the compass arc and the center of the aircraft symbol. The MFD control range is annunciated by white digits at the end of the mid-range ring. Table 2-1-32 gives the range selections available to the map mode format. When weather radar data is displayed, range is selected through the weather radar controller.

Table 2-1-32. Selectable MFD Control Ranges

Selected Range	Half Range Displayed
5	2.5
10	5.0
25	12.5
50	25.0
100	50.0
200	100.0
300	150.0
500*	250.0
1000*	500.0
NOTE: * Flight plan mode on weather radar controller selected.	

4 Stabilizer (STAB) Off Annunciator

a Deselecting stabilization (with the weather controller STAB button) disables stabilization inputs for the antenna. When disabled, the off condition is annunciated by an amber STAB.

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5 Weather Radar Tilt Angle

a Tilt data is transmitted by the radar tilt control bus. The display range for antenna tilt angle is -15 degrees to +15 degrees. Antenna tilt is displayed in 0.5 degree increments between -5 degrees and +5 degrees. For tilt angles greater than ±5 degrees, the resolution is in 1.0 degree increments. Tilt values are preceded by no sign (blank) for positive values and a minus sign (-) for negative values. A degree sign (°) appears after the tilt angle.

6 Target Alert/Variable Gain Annunciator

a The annunciations for TGT and VAR are identical to those previously described. However, when radar gain is selected as a variable, a value proportional to the radar controller gain setting is also displayed.

7 Weather Radar Mode Annunciator

a All basic weather radar modes, except weather radar range and STAB off, are annunciated on line 1. Refer to Table 2-1-33 for details.

b The RTA uses hardware and software monitors to detect and identify faults within the radar system. If WX fails, an amber FAIL message appears in the mode annunciator field. Faults are logged into nonvolatile memory by a unique fault code number. Readout of the fault memory contents can be accomplished by setting the mode selection knob on the WC-880 controller to TST. Fault codes are displayed in the antenna tilt angle field. If more than one code is associated with the failure, the numbers toggle between the different fault codes.

c Refer to Section 2.4 for specific information on fault code interpretation.

Table 2-1-33. Weather Radar Mode Annunciations on MFD

Weather Radar Mode	Annunciator	Color
R/T in warm-up	WAIT	Green
REACT mode	RCT	Green
Forced standby	FSBY	Green
Standby	STBY	Green
Test mode	TEST	Green
Weather mode	WX	Green
Groundmap mode	GMAP	Green
Flight plan mode	FPLN	Green
R/T fail	FAIL	Amber
R/T off	OFF	Green
WX interface failure	WX	Amber

Table 2-1-33. Weather Radar Mode Annunciations on MFD (cont)

Weather Radar Mode	Annunciator	Color
RCT (PRIMUS 880 only)	R	Amber
Weather and turbulence (PRIMUS 880 only)	WX/T	Green
RCT and turbulence (PRIMUS 880 only)	R/T	Green

d A magenta TX annunciator is displayed when the TEST, WX, or GMAP modes are activated from the weather controller while the aircraft is on the ground, and the full compass mode is displayed on the PFD.

8 Weather Radar Returns

a Weather radar returns (picture data) appear within the confines of a baseball diamond shaped area, bounded on the outer edge by the compass arc. The returns are color coded as shown in Table 2-1-34. The weather radar picture data is displayed in a 120-degree pattern.

Table 2-1-34. MFD Weather Radar Color Code

Return	WX Mode	GMAP Mode
Level 1	Green	Cyan
Level 0	Black	Black
Level 2	Amber	Amber
Level 3	Red	Magenta
Level 4	Magenta	Not applicable
REACT	Cyan	N/A

(d) MFD Map Mode Failure and Warning Displays

1 MFD map format failure and warning messages shown in Figure 2-1-39 give an indication of system malfunctions. The paragraphs that follow describe each failure and warning message.

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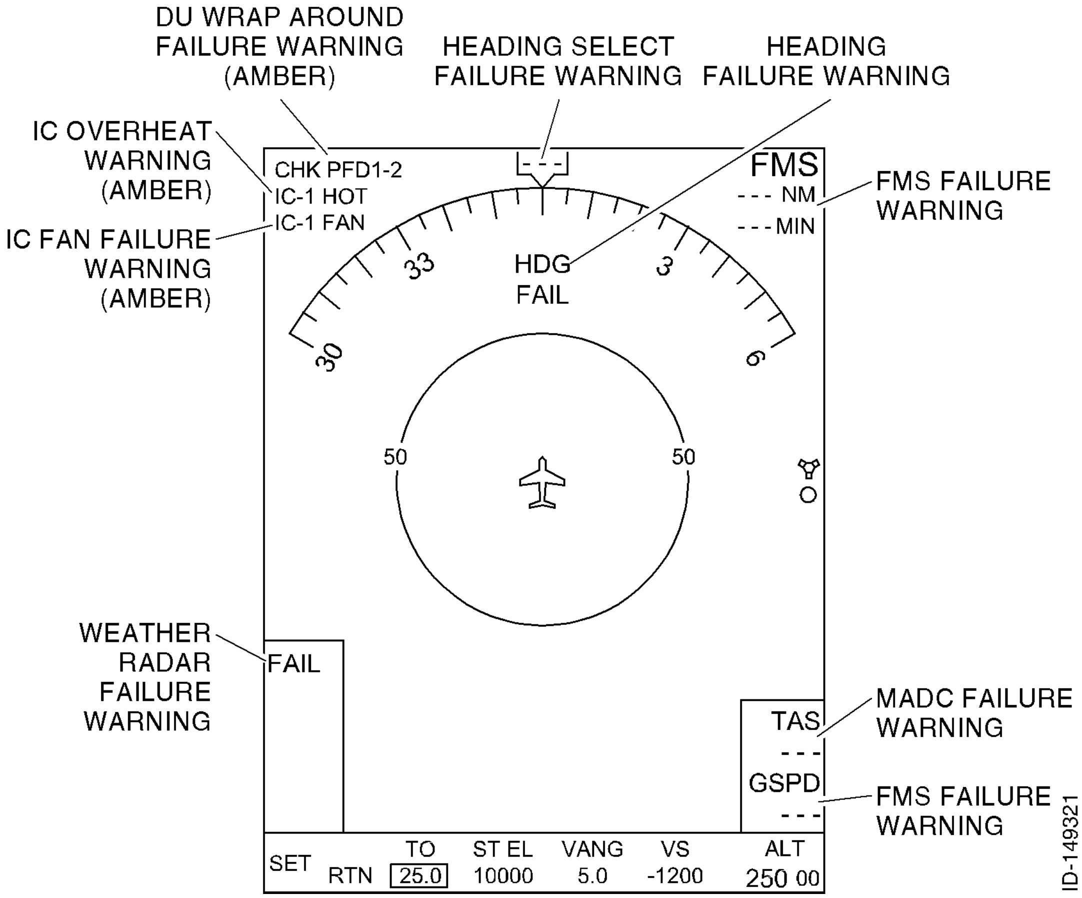

Figure 2-1-39. MFD Failure and Warning Displays

2 IC Fan Failure Warning

a The status of the cooling fans on both IC-615 IACs are monitored continuously by internal sensors. If the cooling fan(s) fails, a message indicating the most probable cause of the warning is displayed. Message annunciations in this field are given in Table 2-1-35.

Table 2-1-35. Fan Failure Warning Messages

Message	Color	Description
IC-1 FAN	Amber	IC-615 IAC No. 1
IC-2 FAN	Amber	IC-615 IAC No. 2
IC-1-2 FAN	Amber	IC-615 IAC No. 1 and No. 2

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3 IC Overheat Warning

a The temperature of both IC-615 IACs are continuously monitored by internal sensors. If the sensor detects a temperature between 110 °C and 140 °C, a failure message is displayed indicating which IAC is over temperature. If the temperature is greater than 140 °C, the IAC shuts down. The messages available for annunciation in this field are given in Table 2-1-36.

Table 2-1-36. IC Overheat Warning Messages

Message	Color	Description
IC-1 HOT	Amber	IC-615 IAC No. 1
IC-2 HOT	Amber	IC-615 IAC No. 2
IC-1-2 HOT	Amber	IC-615 IAC No. 1 and No. 2

4 DU Wraparound Failure Warning

a If either IC-615 IAC detects a wraparound failure (miscompare) on either PFD, a message is displayed indicating which PFD has failed. Messages available for annunciation in this field are given in Table 2-1-37.

Table 2-1-37. DU Wraparound Failure Warning Messages

Message	Color	Description
CHK PFD1	Amber	IC-615 IAC No. 1
CHK PFD2	Amber	IC-615 IAC No. 2
CHK PFD1-2	Amber	IC-615 IAC No. 1 and No. 2

5 Heading Select Failure Warning

a Failure of the heading select signals causes the numerical heading information to be replaced by amber dashes and the heading bug to be removed from the display. This indication is also given in the event of an invalid heading display.

6 Heading Failure Warning

a Failure of the displayed heading from the DG is shown by removing the flight plan from the display. The digital heading readout is replaced by amber dashes. Additionally, a red HDG FAIL message is displayed at the top center of the display.

7 FMS Failure Warning

a A failure of the FMS removes the active flight plan, navaids, and airports from the display. This indication is also given in the event of an invalid heading display. The digital GSPD window is replaced by amber dashes.

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8 MADC Failure Warning

a MADC failures are indicated by replacing the TAS numerical values with amber dashes.

9 Weather Radar Failure Warning

a Weather radar failure is annunciated by an amber FAIL in the weather radar mode annunciator box.

(e) MFD Plan Mode Format

1 The plan mode shown in Figure 2-1-40 has the following features:

- True north-up map presentation
- Heading source annunciator (when cross-side heading source is selected)
- FMS source annunciator
- FMS waypoint annunciators
- FMS waypoint, airport, and navaid display provisions.

NOTE: Weather symbols are not available in the plan format.

2 The plan mode format shown in Figure 2-1-40 is a north-up presentation of the active flight plan. The active waypoint is displayed in magenta at the center of the display. Track line orientation is true north. A 3-inch range ring, showing the selected display range, is centered about the active waypoint. The home position of the designator (cursor) is at the center of the range ring. The color of the aircraft symbol is changed from white to yellow and is displayed at the present position. In the plan mode, gyro-stabilized magnetic compass information is used to orient the aircraft symbol as it moves around the flight plan. Flight plan data does not need valid heading to be displayed in this mode.

3 When checklist or TCAS is selected for display, the plan presentation shifts toward the top of the display to maximize the plan presentation.

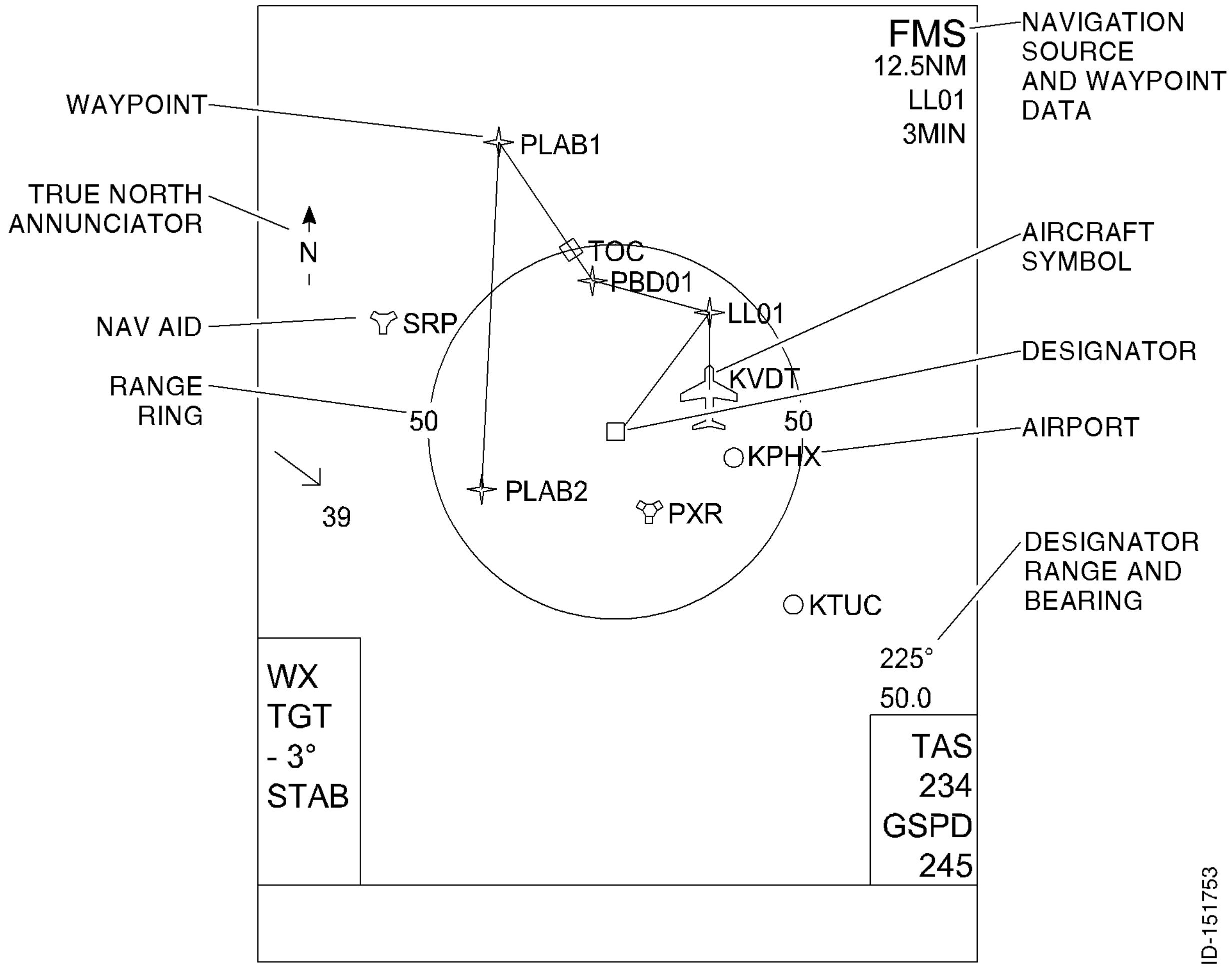

Figure 2-1-40. MFD Plan Mode Format

4 Navigation Source and Waypoint Data

a The navigation source and waypoint data are identical to those previously described for the MFD map format.

5 Aircraft Symbol

a The yellow aircraft symbol moves in the display as a function of aircraft present position. The aircraft symbol gives a visual cue to the actual aircraft position relative to true north and the active flight plan.

6 Designator

a The operation of the designator in the plan mode is the same as for the map mode, except that the default reference point is the TO waypoint. The designator symbol is always located in the center of the display, and the flight plan is moved whenever the designator is scrolled to a new reference waypoint or is offset from the current waypoint.

b The primary purpose of the joystick and designator in the plan mode is to position the circular viewing ring so that either the route being flown or the maneuvering aircraft can be better observed. This feature is especially useful in maintaining position orientation in the terminal area as the aircraft is being vectored in for final approach. A bearing and distance display of the designator's position relative to its anchor waypoint is also shown in the lower right corner.

7 Flight Plan Symbols

a Flight plan waypoints, navaids, and airports are transmitted by the FMS over an ARINC 429 bus. These displays are identical to those previously described for the MFD map mode.

8 Designator Range and Bearing

a The designator range and bearing is the same as previously described in the map mode.

9 Range Ring

a A range ring circle is displayed to aid in determining the position of the active flight plan parameters. The circle radius corresponds to the MC-800 MFD controller selected range in nautical miles. Available range selections are 5, 10, 25, 50,100, 200, 300, 600, and 1200 NM.

10 True North Annunciator

a The symbol for the north-up arrow has two elements, a large N and an arrow pointing up. The north-up symbol is displayed in white, on the left portion of the plan format.

11 Plan Format Failures

a The plan mode failures, as shown in Figure 2-1-41, indicate a system malfunction. The paragraphs that follow describe each failure.

b Heading Failure Warning

(1) Loss of valid heading information removes the aircraft symbol and moves the TO waypoint to the center of the display, if not already there. Additionally, a red HDG FAIL message is displayed at the top center of the plan range ring. Map data remains displayed.

c FMS Failure Warning

(1) FMS failure indications are identical to those described for the MFD map mode.

d MADC Failure Warning

(1) MADC failure indications are identical to those described for the MFD map mode.

e IC Fan, IC Overheat, and DU Wraparound Warning Messages

(1) IAC fan failure, IAC overheat, and DU wraparound warning messages are identical to those described for the MFD map mode.

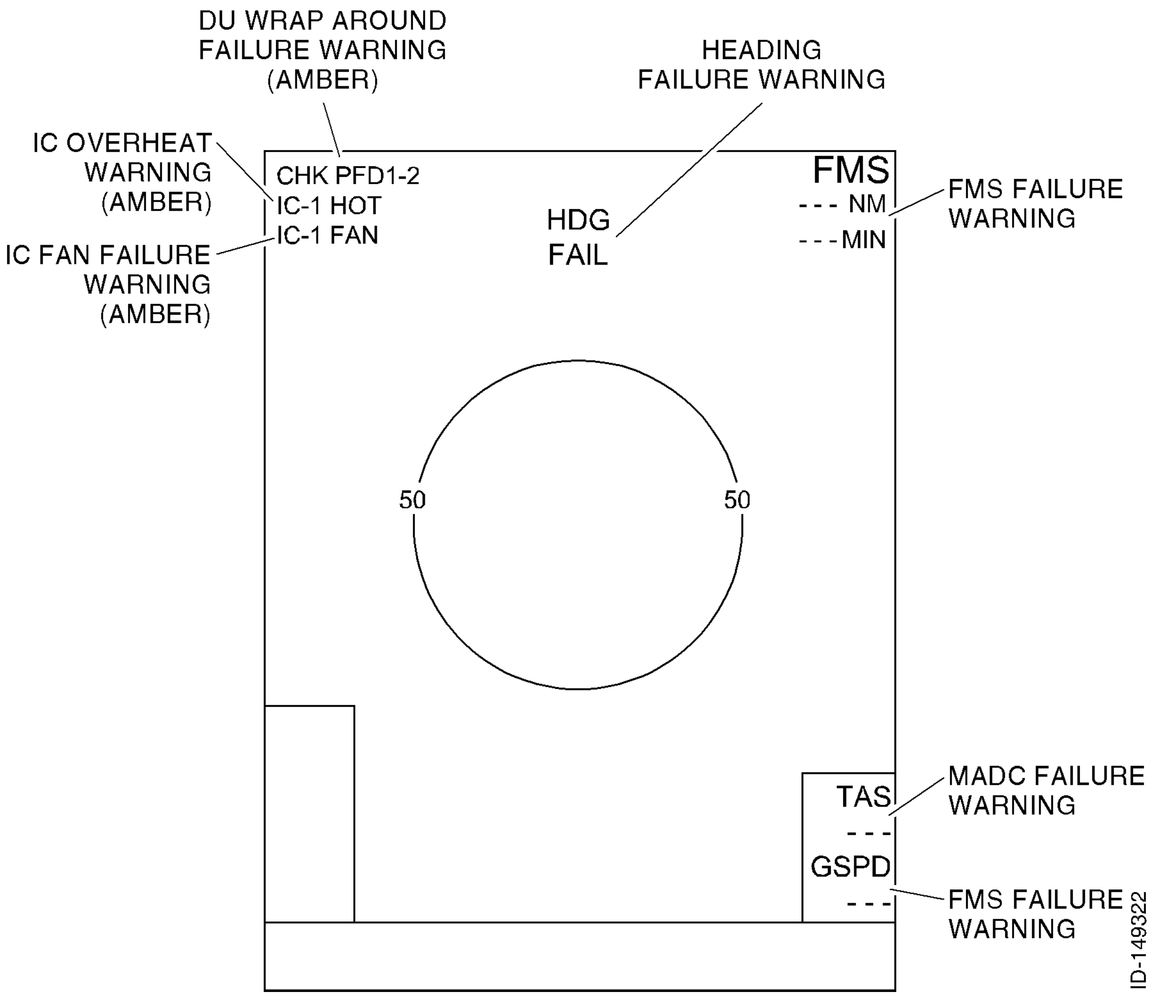

Figure 2-1-41. MFD Plan Format Failure Displays

(f) MFD Window

1 The checklist and TCAS displays are supplied by means of an MFD window. When either function is selected, the map or plan navigation displays are slightly repositioned toward the top of the display area. The MFD window is then shown on the bottom portion of the display between the lower left and lower right windows.

NOTE: When checklist or TCAS is displayed, a portion of the MFD's map or plan mode may be removed to give more space.

2 MFD Checklist Display

a The checklist window is displayed with either the MFD map or plan mode, as shown in Figure 2-1-42. Normal, abnormal, and emergency checklist information stored in each IC-615 IAC is displayed. The IC-615 IAC stores up to 400 pages of pilot-defined text in nonvolatile memory. Page composition is 12 lines with a maximum of 26 characters per line. All text is stroke written for readability in direct sunlight. These 400 pages may be subdivided in any ratio between normal, abnormal, and emergency checklists and must contain at least one index page for each subdivision.

NOTE: The aircraft operator is responsible for downloading the actual checklist text into the IC-615 IAC.

NOTE: When an IC-615 IAC is removed, the stored checklist is also removed. Make sure that the proper checklist crossloading and operational checklist generation and storage procedures are followed. Failure to do so could result in a total loss of the defined checklist.

NOTE: The checklist is loaded into the IC-615 IAC over an RS-232 interface plug and a personal computer. Refer to Section 4 for checklist uploading and downloading procedures.

b An index page is a listing of the procedures (collection of items) that an operator may review. A checklist page is a detailed listing of emergency and abnormal items within a particular procedure. The master index page, as shown in Figure 2-1-42, shows the normal, emergency, and abnormal indexes as options to be selected. The NORM button on the MC-800 MFD controller gives access to the checklist master index.

c Refer to paragraph 2.F. for specific button information on how to access and manipulate the checklists and indexes with the MC-800 MFD controller.

Figure 2-1-42. Typical Checklist Display

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3 TCAS Display Symbols

a The TCAS window, shown in Figure 2-1-43, is activated in one of two ways:

- When TCAS is selected through the MC-800 MFD controller
- When the automatic pop-up mode is enabled through a TCAS control head, if the checklist is not active.

b The TCAS window is the same size and location as the checklist window. However, MFD TCAS auto display is not permitted to override the checklist window. Checklist has highest priority.

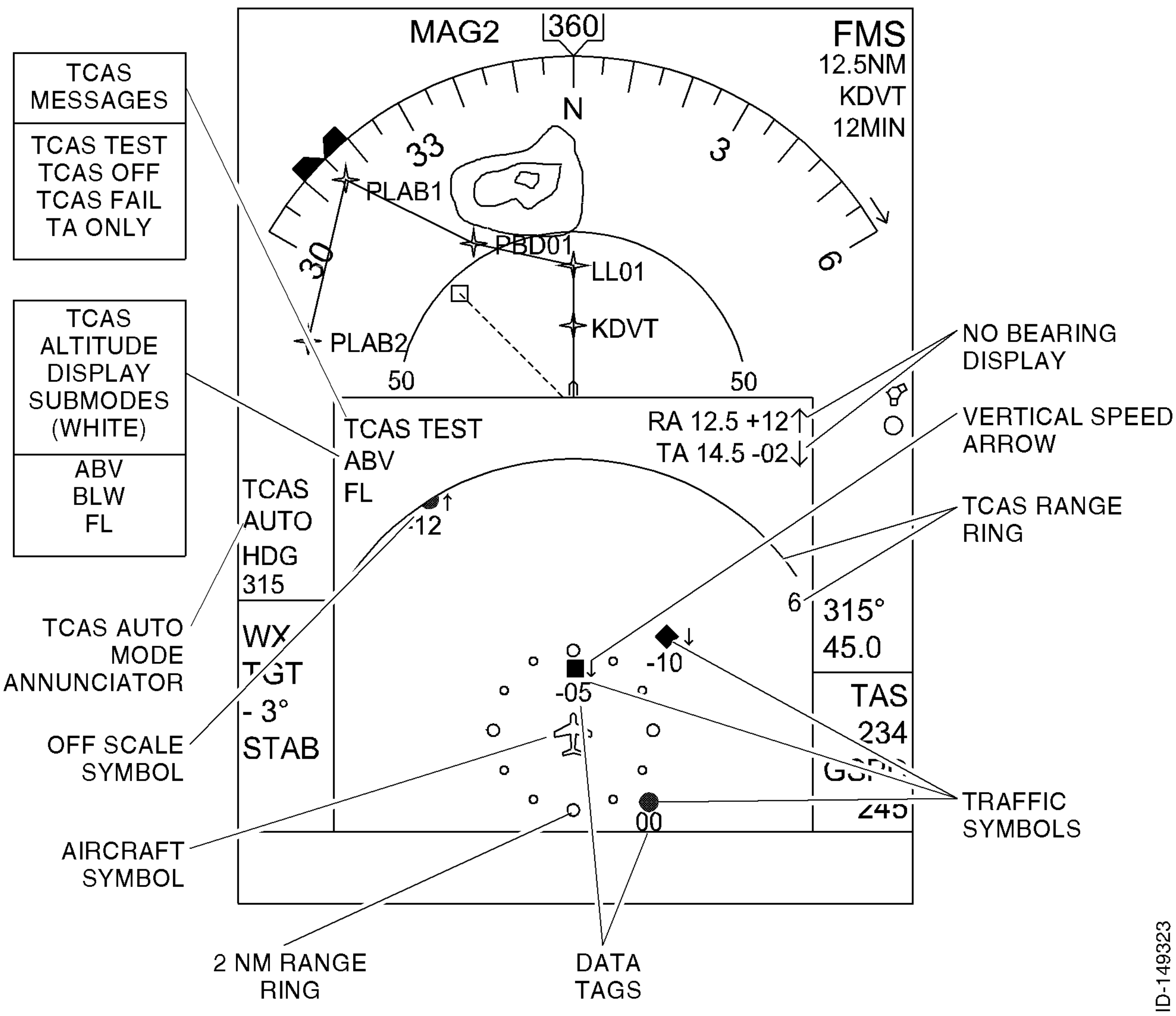

Figure 2-1-43. MFD TCAS Display Symbols

c The TCAS window display symbols are described in the paragraphs that follow.

d No Bearing Display

(1) Bearing messages (text) are displayed on two lines (or fields) in the upper right side of the TCAS window whenever the system encounters an RA or TA target that has range, but no bearing information for display. The color of each line is based on the type of intruder. The first line contains the message RA NO BRG in red for an RA without bearing and the second line contains the message TA NO BRG in amber for a TA without bearing information.

e TCAS Range Ring

(1) The range ring boundary is a white full arc (range ring) shown at the limits of the display window. The distance between the arc and the aircraft symbol is displayed in NM to the right of the arc.

(2) Since the MC-800 controls map/plan mode range and not TCAS, the range ring is proportional to the MFD selected range. The displayed TCAS range is based on information transmitted over an ARINC 429 bus from the TCAS control head. The MFD software (IC-615 IAC) supports 3, 6, 10, 12, 14, 15, 20, 25, 40, and 50 NM range selections in the TCAS mode. All other range selections received over the ARINC bus are defaulted to 6 NM.

f Traffic Symbols

(1) TCAS uses color-coded symbols and data tags to map traffic and locate threat aircraft on the MFD. Four types of traffic symbols are used: solid square, solid circle, solid diamond, and a hollow (open) diamond. A different color is assigned to each symbol type, as given in Table 2-1-38.

Table 2-1-38. Traffic Symbols

Graphic Symbol	Color	Display Function
Solid square	Red	Resolution advisory (RA)
Solid circle	Amber	Traffic advisory (TA)
Solid diamond	Blue	Proximate traffic
Hollow diamond	Blue	Other traffic

(2) Red represents an immediate threat to a TCAS-equipped aircraft. Prompt action is required to avoid the intruder. This color is only used in conjunction with a resolution advisory.

(3) Amber represents a moderate threat to a TCAS-equipped aircraft. A visual search is recommended to prepare for intruder avoidance. Amber is used only in conjunction with traffic advisory.

(4) Cyan represents proximate traffic and other traffic the TCAS surveillance logic has in its track file. White is used only for mode annunciations and for reference graphics, including aircraft home position, range ring, and vertical speed scale.

(5) The display functions of the traffic symbols are described in the paragraphs that follow.

(6) Resolution Advisory

(a) Intruder aircraft entering the warning area 20 to 30 seconds from the TCAS collision area are represented as a solid red square. This type of traffic results in an RA.

(7) Traffic Advisory

(a) Intruder aircraft entering the caution area 35 to 45 seconds from the TCAS collision area are represented as a solid amber circle. This type of traffic results in a TA.

(8) Proximate Traffic

(a) Aircraft within display range and within the selected vertical window are represented as a solid cyan diamond. Proximate traffic is shown to improve situational awareness in the event of a potential conflict with higher priority RA or TA aircraft.

(9) Other Traffic

(a) Any transponder-replying traffic that is not classified as an intruder or proximate traffic within the display range and within the selected vertical window are represented as hollow cyan diamonds (only in view when no RA or TA is in progress). The predicted flightpaths of proximate traffic and other traffic do not penetrate the collision area of the aircraft.

(10) RA and TA Off Scale Symbols

(a) Threat traffic (RA and TA) that have gone beyond the displayed range are shown as amber half (off scale) symbols. The half symbol is placed at the edge of the active display area at the correct relative bearing to own aircraft. Proximate traffic and other traffic are not displayed when out of range.

g Vertical Speed Arrow

(1) The intruder vertical speed indication is an arrow positioned to the right of the associated traffic symbol. If the arrow is pointing up (↑), it means that the intruder aircraft is climbing at a rate greater than 500 ft/min, and if the arrow is pointing down (↓), the intruder is descending at a rate greater than 500 ft/min. The color of the arrow matches that of the corresponding traffic symbol. The vertical speed arrow is not displayed for traffic in level flight (no vertical rates).

h 2 NM Range Ring

(1) Whenever the selected range is <20 NM, a white range ring made up of 12 dots is placed in a radius of 2 NM around the airplane symbol. The dots are arranged so that one dot is placed at each of the clock hour positions, with the aircraft symbol current heading at 12 o'clock.

(2) If the range is ≥20 NM, a white half arc is displayed in place of the ring. The half arc is positioned midpoint between the aircraft symbol and the TCAS range ring (white full arc). The range ring is intended to assist in interpreting TCAS traffic information.

i Aircraft Symbol

(1) A white airplane symbol representing the aircraft's own position is displayed in the lower center of the TCAS window.

j Data Tags

(1) Associated with each intruder is a data tag indicating the relative or absolute altitude. The data tag may include the vertical speed arrow. When relative altitude of an intruder aircraft is available, a data tag indicating relative altitude is displayed with the corresponding traffic symbol. The color of the tag is the same as the symbol.

(2) Absolute altitude, or flight level (FL), of the intruder aircraft is displayed when selected through a TCAS control head. The IC-615 IAC calculates the absolute altitude by adding the relative altitude (provided by the TCAS computer) to its own aircraft's barometric altitude.

(a) The relative altitude data tag is made up of a two-digit number preceded by a plus (+) or minus (-) sign, either above or below the intruder aircraft symbol. The digits represent the relative altitude of the intruder, in hundreds of feet, as referenced to the TCAS-equipped aircraft. A plus (+) means that the intruder is above own aircraft, and a minus (-) means that the intruder is below. The data tag appears in the same color as the traffic symbol.

(b) The absolute altitude tag is displayed in place of the relative altitude data tag whenever an RA or TA condition is encountered. Absolute altitude uses three digits to indicate hundreds of feet. The value is rounded to the nearest 100 ft above mean sea level (e.g., 23,500 is displayed as 235), and if appropriate leading zeros are displayed. Positive values have no sign, while negative values are followed by a minus (-) sign (i.e., -2,100 ft is displayed 21-).

(3) The color of the absolute altitude data tag matches the color of the corresponding traffic symbol. Absolute altitude stays up 10 seconds after the request ends.

k TCAS Auto Mode Annunciator

(1) When TCAS auto mode is selected, TCAS AUTO is annunciated on the display in white. The TCAS window can be brought up automatically whenever appropriate traffic is encountered. The level of traffic that triggers the pop-up window is selected through a TCAS control head. TCAS can direct that only RAs or TAs trigger the window, or RAs, TAs, and proximate traffic.

(2) Automatic display of TCAS on the MFD is shown at the last selected TCAS range. However, the first selection of TCAS on the MFD after power-up always presents the 6 NM range.

l TCAS Altitude Display Submodes

(1) Above/Below Target Annunciator

(a) The TCAS above (ABV) and below (BLW) target annunciators are displayed below the TCAS message field. Target annunciations are based on relative altitude limits sent by the TCAS computer. TCAS can look well above or below the normal TCAS altitude. The above or below condition is displayed as ABV or BLW in white in the upper left corner of the TCAS window.

(2) Absolute Altitude (Flight Level) Annunciator

(a) When absolute altitude is selected, a white FL flight level annunciator is displayed below the ABV/BLW annunciator.

m TCAS Mode Annunciation

(1) TCAS messages are annunciated in the upper left corner of the TCAS window. The message is displayed whenever the MFD window format is in TCAS mode. If TCAS is in the automatic mode, TCAS AUTO is annunciated in white above the WX mode field. The mode messages given in Table 2-1-39 are in order of display priority.

Table 2-1-39. MFD TCAS Messages

Message	Color	Description
TCAS TEST	White	Indicates functional test in progress
TCAS OFF	White	Displayed when TCAS is off
TCAS FAIL	Amber	Indicates TCAS system failure

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Table 2-1-39. MFD TCAS Messages (cont)

Message	Color	Description
TA ONLY	White	Traffic alert on
TCAS	White	Displayed if TCAS is selected for display and none of the above TCAS annunciations are currently displayed

(g) Display Menu Window

1 Top-Level MFD Menu

a At power-up, the top-level menu is displayed, as shown in Figure 2-1-44. The top level menu page allows selection of the three MFD submenu pages and includes the full-time altitude select set function. From here the pilot can select the VNAV submenu page, the takeoff speeds (T/O SPEEDS) submenu page, or the landing speeds (LNDG SPEEDS) submenu page by pushing the bezel button below the menu item.

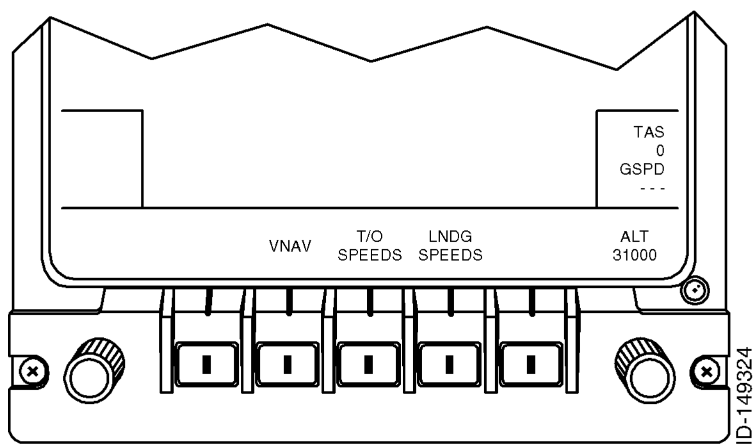

Figure 2-1-44. Top Level MFD Menu Page

2 VNAV Submenu Page

a The VNAV submenu page, as shown in Figure 2-1-45, allows selection of to/from distance, station elevation (ST EL), vertical angle (VANG), and selected altitude. Pushing the RTN key always returns the menu display to the top-level MFD menu page, not the previous submenu page. A digital readout of the predicted VS is also displayed in the menu but cannot be adjusted by the pilot. VS is automatically calculated and displayed based on data entered. The digital readout of the VNAV parameters are all dashed unless the pilot has previously entered values on this menu. VNAV parameters are given in Table 2-1-40.

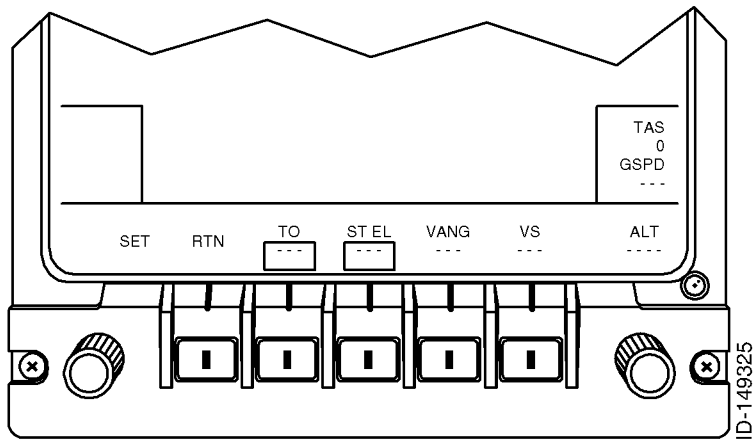

Figure 2-1-45. VNAV Submenu Page

Table 2-1-40. VNAV Data Parameters

Parameter	Units	Range	Resolution
ALT (altitude)	feet	0 to 50,000	Hundreds of feet
ST EL (station elevation)	feet	0 to 10,000	100 ft
TO or FR (to or from)	NM	0.1 to 99.9	Tenths of NM
VANG (vertical angle)	degrees	0.1 to 5.9	Tenths of a degree

b TO/FR Button

(1) Pushing the bezel button below the TO legend causes a box to be displayed around the dashed distance readout. At this point the pilot has three options as follows:

- Push another bezel button that moves the box to the next parameter.
- Push the TO bezel button again and change the TO legend to FR.
- Turn the SET knob and select a distance TO or FR the VOR station.

(2) Once a distance value has been entered with the SET knob, the pilot has the option of selecting another set parameter, which moves the box to the new parameter, or pushing the distance bezel button again to toggle between to or from distance. If a TO distance is set and FR is selected and set, the TO distance changes to cyan dashes. If a FR distance is set and TO is selected and set, the FR distance changes to cyan dashes. TO/FR distance is always positive and limited to 99.9 miles.

c ST EL Button

(1) Station elevation is present if the HSI NAV source is a VOR. If a LRN source is selected for display on the HSI, the ST EL legend and digits display are not present. Pushing the bezel button below ST EL legend causes a box to be displayed around the digits. The pilot can set a digital value in the box with the SET knob. After a value has been entered, the pilot can push another bezel button that moves the box to the new parameter.

d VANG Button

(1) The VANG option is primarily a display window but also lets the pilot manually increase the angle displayed in the window. Once a valid problem has been defined (this requires a selected altitude, a distance, and a station elevation if VOR is displayed on HSI), the vertical angle becomes valid and is displayed in the VANG position. As the pilot manipulates other parameters (distance or selected altitude), the vertical angle changes accordingly. This includes going to dashes or becoming valid, depending on the validity of the problem. Once a valid angle (less than 6 degrees) has been displayed in the window, the pilot has the following two options:

- Select the VNAV mode on the MS-560 mode selector to engage the flight director mode and freeze all VNAV parameters.
- Push the VANG bezel button (a box appears around the digital readout of vertical angle), manually increase the vertical angle with the SET knob (maximum limit ±6 degrees), and select VNAV on the MS-560 mode selector to arm the VNAV mode and freeze all VNAV parameters.

(2) If a valid vertical angle is being displayed, the predicted vertical speed is also valid and displayed. The predicted vertical speed provides an estimate of the climb or descent rate that would be achieved for the existing airspeed and selected vertical angle. The predicted vertical speed is removed as soon as the VNAV mode is captured.

3 T/O SPEEDS Submenu Page

a The T/O SPEEDS submenu, as shown in Figure 2-1-46, lets the pilot select and set three different airspeed references: V1, VR, and V2. Airspeed references are displayed as fixed or moving bugs (1, R, and 2) on the PFD airspeed scale. Table 2-1-41 gives the T/O SPEEDS parameters.

b At power-up all Vspeed values are invalid and deselected. (Cyan dashes are displayed under the respective airspeed reference.) Pushing a bezel button for a particular reference speed (V1, VR, or V2) for the first time replaces the dashes with a default Vspeed value (cyan digits). Two white boxes also appear: one small inner box around the default Vspeed value and one large box around the inner box and its title. The word SET above the left-hand rotary knob indicates that data input control has been transferred to this knob.

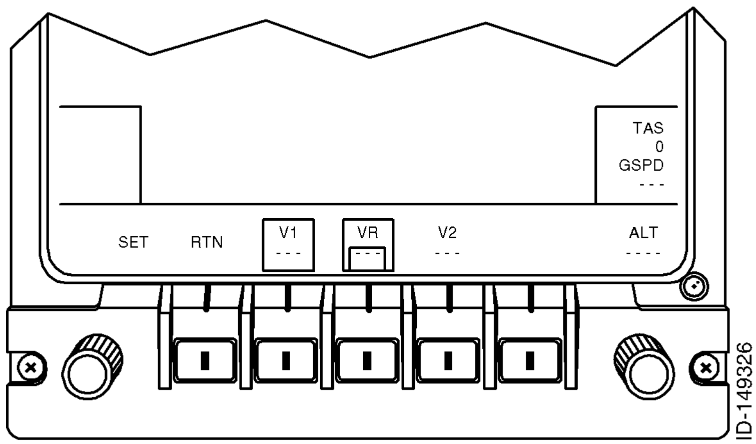

Figure 2-1-46. T/O SPEEDS Submenu Page

c The two boxes denote that Vspeed is active and is selected for display. When the SET knob is rotated to dial in the desired Vspeed reference value, incrementing or decrementing digits appear accordingly and the speed bug on the airspeed scale is positioned, if in view. When the desired value is set, a second push of any bezel button (except the active Vspeed reference or RTN) boxes the value and its title. The smaller inner white box is removed to indicate that a new reference value for Vspeed display has been entered. Vspeeds are set with the criteria given in Table 2-1-41.

d Selecting a speed reference that has only the large box displayed removes the outline box and its respective bug, but the digits remain at the previously set value.

Table 2-1-41. T/O Vspeed Data Parameters

Parameter	Criteria
T/O Vspeed order	T/O Vspeed order of V1, VR, V2 is always maintained in value of magnitude
V1	V1 can be set equal to but never higher than VR
VR	VR can be set equal to but never lower than V1
V2	V2 can never be set any lower than VR
V1 set start	V1 set starts at 100 knots

Table 2-1-41. T/O Vspeed Data Parameters (cont)

Parameter	Criteria
VE	VE is fixed at 150 knots: it serves as an enroute and terminal area speed bug
Vspeed deselect	Vspeeds automatically deselect and turn invalid when actual air speed exceeds 200 knots

e The 1, R, and 2 bugs and the white box around the digits are automatically removed from the PFD anytime airspeed transitions from below-to-above, 200 knots (increasing airspeed). Vspeed can be selected again at any airspeed. However, if the aircraft transitions from below to above 200 knots again, Vspeed is removed from the PFD.

f Anytime Vspeeds are set, the V-enroute E bug is displayed at the appropriate position on the airspeed scale.

g When the SET knob is used to adjust a speed value with cyan dashes displayed, an initial starting point for each Vspeed is supplied. The starting speed for V1 is 100 knots. The starting point for VR is 100 knots or V1, if V1 has a set value. The starting point for V2 is 100 knots or VR, if it has a set value. Selecting any of the takeoff speeds for display on the PFD automatically displays the enroute speed bug.

4 LNDG SPEEDS Submenu Page

a This submenu page, as shown in Figure 2-1-47, lets the pilot select and set two different airspeed references (VREF and VAPP). When selected, the references are displayed as fixed or moving bugs (RF and AP) on the PFD airspeed scale. Table 2-1-42 gives the LNDG SPEEDS parameters.

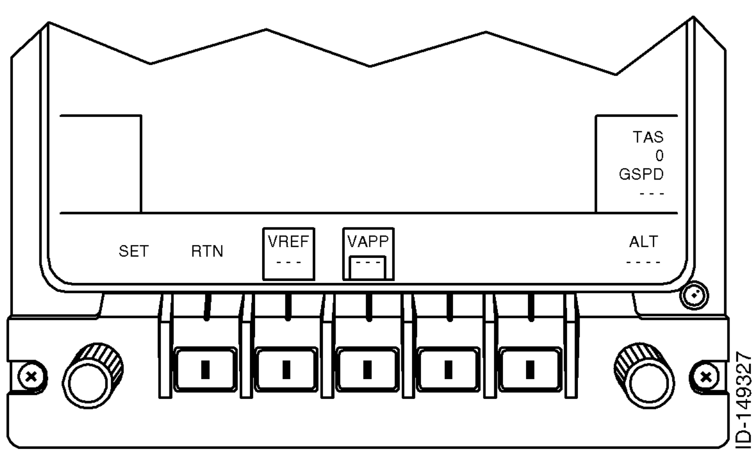

Figure 2-1-47. LNDG SPEEDS Submenu Page

b At power-up, cyan dashes are displayed under the respective airspeed reference. Selecting a particular reference speed (VREF and VAPP) for the first time replaces the dashes with a default Vspeed value. Two white boxes also appear, one small inner box around the default Vspeed value and one large box around the inner box and its title. The word SET above the left-hand rotary knob indicates that data input control has been transferred to this knob.

c The two boxes denote that the Vspeed is active and is selected for display. When the SET knob is rotated to dial in the desired Vspeed reference value, incrementing or decrementing digits appear accordingly, and the RF or AP bug on the PFD airspeed scale is positioned, if in view. When the desired value is set, push any bezel button except the active Vspeed reference or RTN. The smaller inner white box is removed to indicate that a new reference value for Vspeed has been entered for display. Repeat this procedure for VAPP. Remember not to use the RTN bezel button to enter the data. Vspeeds (VREF and VAPP) are set with the criteria given in Table 2-1-42.

d Similarly, selecting any one of the other buttons causes two white boxes to appear on the newly selected Vspeed, and a single white box remains around the title and digits of the previously selected Vspeed. Selecting a speed reference that has both boxes displayed causes the outline box and its respective bug to be removed, but the digits remain at the previously set value.

e When the SET knob is used to adjust a speed value with cyan dashes displayed, an initial starting point for each Vspeed is supplied. The starting speed for VREF and VAPP is 95 knots.

Table 2-1-42. LNDG Vspeed Data Parameters

Parameter	Criteria
Landing Vspeed order	Landing Vspeed order of VREF, VAPP is always maintained in value of magnitude.
VAPP	VAPP can be set to 40 to 450 knots. The default is 95 knots. If VREF is set first, then VAPP = VREF.
VREF set start	VREF set starts at 95 knots.
Landing Vspeeds	Landing Vspeeds remain displayed until power is removed.
V1 set start	V1 set starts at 100 knots.

4. Fault Monitoring and Display System Reversionary Modes

A. General

(1) The pilot can select which symbol generator is driving the displays and alternate heading, attitude, and air data sources by using the MC-800 MFD controller MODE switch or external cockpit mounted ATT REV, HDG REV, and ADC REV switches.

(a) EDS 1 (No. 1 Normal) Failure

1 As previously noted, a failure of EDS 1 (or its interface) is indicated in one of the following manners:

- Red **X** on the No. 1 PFD
- Red **X** on the MFD
- Red **X** on both the No. 1 PFD and MFD.

2 The reversionary mode for this failure is to turn the MC-800 MFD controller MODE knob from the NORM to the SG2 position. The IC-615 IAC No. 2 then drives all three DUs.

(b) EDS 2 (No. 2 Normal) Failure

1 A failure of EDS 2 (or its interface) is indicated by a red **X** on the copilot's PFD.

2 The reversionary mode for this failure is to turn the MC-800 MFD controller MODE knob from the NORM to the SG 1 position. The IC-615 IAC No. 1 now drives all three DUs.

(c) Attitude Reversionary

1 Using the ATT REV switch, the pilot can select attitude sources as given in Table 2-1-43.

Table 2-1-43. Attitude Reversionary Switch Functions

Condition	Pilot	Copilot
Power-up	ATT 1	ATT 2
First push	ATT 2	ATT 1
Second push	ATT 1	ATT 2

NOTE: DG1 or DG2 can be given as a compass source depending on the compass management

(d) Heading Reversionary

1 Using the HDG REV switch, the pilot can select heading sources as given in Table 2-1-44.

Table 2-1-44. Heading Reversionary Switch Functions

Condition	Pilot	Copilot
Power-up	MAG 1	MAG 2
First push	MAG 2	MAG 1
Second push	MAG 1	MAG 2

NOTE: DG1 or DG2 can be given as the compass source depending on compass management.

(e) Air Data Computer Reversionary

1 Using the ADC REV switch, the pilot can select air data sources as given in Table 2-1-45.

Table 2-1-45. Air Data Computer Reversionary Switch Functions

Condition	Pilot	Copilot
Power-up	ADC 1	ADC 2
First push	ADC 2	ADC 1
Second push	ADC 1	ADC 2

B. DU-1080 Display Unit Failure

(1) If there is a power failure to the unit or the unit fails, the display goes blank.

C. DC-550 Display Controller Failures

(1) If the No. 1 DC-550 fails, the following defaults are in effect:

- Full compass on PFD, WX OFF
- SC/CP remains as it was before the DC went invalid
- GSPD on PFD
- Elapsed time not selected for display and reset
- MADC source remains as it was before the DC went invalid
- Primary VOR selected for display on PFD
- Primary LRN not selected for display on PFD (always selected for display on MFD)
- If IC-615 IAC No. 1, circle bearing (blue) selecting its primary VOR (VOR1)
- If IC-615 IAC No. 2, circle bearing is OFF
- If IC-615 IAC No. 1, diamond bearing (green) OFF
- If IC-615 IAC No. 2, diamond bearing selecting primary VOR (VOR2)
- Test not selected
- Attitude source remains as it was before the DC-550 went invalid
- Heading source remains as it was before the DC-550 went invalid
- All flight director modes on PFD not active
- Selected course remains as it was before the DC went invalid
- Selected heading remains as it was before the DC-550 went invalid
- MFD top-level menu selected
- VNAV select remains as it was before the DC-550 went invalid; all VNAV parameters remain as they were set
- Baro set type remains as it was before DC-550 went invalid
- Vspeed sets remain as they were before the DC-550 went invalid
- Vspeeds selected for display remain as they were before the DC went invalid
- Run-time lamp test OFF
- PFD DU reversion remains as it was before the DC-550 went invalid.

D. MC-800 MFD Controller Failure

(1) If the MC-800 MFD controller fails, all MFD-controlled selections remain as they were before the controller failed.

E. DC-550 Display Controller Power-Up Defaults

(1) At power-up (assuming a cold start), the following DC-550 defaults are in effect:

- Full compass on PFD, WX OFF
- SC aircraft symbol on PFD
- GSPD on PFD, always GSPD on MFD (i.e., cannot switch to TTG)
- Elapsed time not selected for display and reset
- Primary ADC selected for display on PFD and MFD
- Primary VOR selected for display on PFD
- Primary LRN not selected for display on PFD (always selected for display on MFD)
- Circle bearing (blue) per bearing switch
- Diamond bearing (green) per bearing switch
- Test not selected
- Primary attitude selected for display on PFD
- Primary heading selected for display on PFD and MFD
- All flight director modes on PFD not active
- MFD top level menu selected
- Baro set on PFD is INCHES
- Vspeed sets equal to canned default values
- Run-time lamp test off
- PFD DU reversion per switch.

(2) Altitude preselect is not initialized at power-up. Instead, it syncs to its set knob once the knob is turned. This syncing is performed by the FD function.

(3) If a warm start, DC-550 display controller button data is restored as it was before the power interrupt, DC-550 switch data follows the appropriate switch.

SECTION 2-2
ADZ-950 MICRO AIR DATA SYSTEM

1. Overview

A. General

(1) The PRIMUS 1000 Integrated Avionics System installed in the Cessna Citation XLS aircraft includes two AZ-950 MADCs. The MADC takes inputs of static air pressure and pitot pressure, total air temperature, and baro set information. The MADC performs the necessary computations and transmits air data information via the ARINC 429 data bus. Each MADC has four low-speed buses that output the same data.

(2) The MADC supplies baro corrected altitude, true airspeed, Mach, and vertical speed information to the IC-615 IACs for primary flight display (pilot and copilot). It also supplies pressure altitude to the TCAS, if installed. The MADC includes static source error correction (SSEC) and outputs an overspeed warning discrete.

(3) Barometric correction is input to the MADC directly from a rotary set knob located on the onside PFD bezel. Air data target values are displayed as digital quantities and are shown as moving bugs on the PFD air data displays.

2. Component Descriptions and Locations

A. AZ-950 MADC

(1) Figure 2-2-1 shows a graphical view of the AZ-950 MADC. The MADCs are located in the avionics nose bay of the aircraft. Table 2-2-1 gives leading particulars for the MADC.

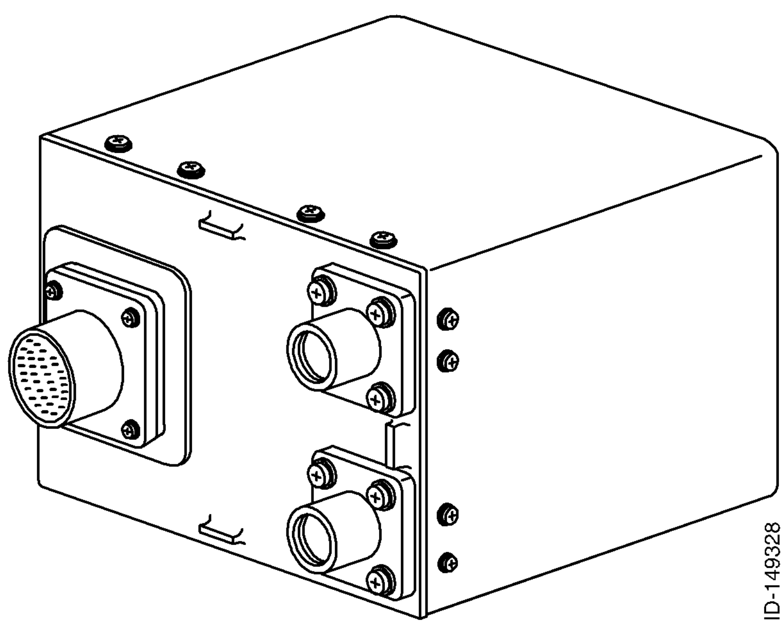

Figure 2-2-1. AZ-950 MADC

Table 2-2-1. AZ-950 MADC Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	4.23 in. (107.44 mm)
• Width	6.23 in. (158.24 mm)
• Length	5.5 in. (139.70 mm)
Weight	4.2 lb (1.905 kg)
Power requirements:	
• Continuous	28 V dc, 16 W (max)
User replaceable parts	None
Mating connectors:	
• Static, straight	MS24393-6 and nut MS24400-6
• Static, elbow	MS24394-6 and nut MS24400-6
• Pitot, straight	MS24393-4 and nut MS24400-4
• Pitot, elbow	MS24394-4 and nut MS24400-4
• Power	MS27473E20B-35S
Mounting	MT-840 tray, HPN 7014702-902

(2) The MADC has two pneumatic connectors that let the MADC accept input of static and pitot pressures through MS-type threaded fittings and a single 79-pin electrical connector for connection of all electrical inputs and outputs. The pitot/static and outside temperature probes (not supplied by Honeywell) measure air pressure and air temperature. The operation of these probes is covered in the appropriate manufacturer's literature. The pitot and static sources/probes deliver air pressures to the sensors in the MADC.

(3) The MADC is mounted in a tray; the tray has no electrical or pneumatic connectors.

(4) The following air data values are output by the AZ-950 MADC:

- Barometric altitude
- Pressure altitude
- IAS
- Mach number
- Vertical speed
- Vmo speed
- SAT and TAT
- TAS.

3. Operation

A. Pilot's Air Data System

(1) Figure 2-2-2 shows the pilot's MADC interface. The inputs to the MADC consist of static and pitot pressure, total air temperature, baro set information, aircraft configuration data, WOW discrete, and a functional test discrete. The pressure inputs are by means of MS-type threaded fittings. The total air temperature input is a 500-ohm, ARINC 575 total air temperature probe.

(2) Baro correction is controlled by the BARO knob. The baro set range is from 16.00 to 32.00 inHg, or from 542 to 1084 hPa. Selection of inHg or hPa is done through the IN/HPA DC-550 display controller button. Rotation of the BARO set knob sends greycode pulses directly to the onside MADC, which supply the MADC with barometric correction information, so as to output altitude above mean sea level (MSL). Clockwise rotation increases inHg in 0.01 increments, or hPa in 1.0 increments. Counterclockwise (CCW) rotation of the knob decreases the selected setting by a like amount.

(3) The STD (standard) button, adjacent to the BARO set knob, commands the MADC to set the barometric correction to 29.921 inHg or 1013.24 hPa.

(4) Aircraft configuration data is supplied by seven discrete inputs. Each input is defined as open or grounded for the type of aircraft. This ensures that the proper MADC is installed, and sets the aircraft dependent parameters of Vmo and SSEC.

(5) Side select data is supplied by three discrete inputs. Each input is defined as open or grounded for the side of the aircraft in which the MADC is installed. This ensures that the MADC receives and transmits the appropriate side air data.

(6) The ADC1 or ADC2 test switch, located on the maintenance panel behind the pilot's seat, is used for functional test.

(7) The WOW input is used to inhibit test during flight.

(8) The ARINC 429 No. 1 output sends air data information to IAC No. 1. The ARINC 429 No. 2 output sends air data information to IAC No. 2. The ARINC 429 No. 3 output sends transponder information to to COM unit No. 1. The ARINC 429 No. 4 output is connected to the PRIMUS 880 weather radar air data input.

B. Copilot's Air Data System

(1) Figure 2-2-3 shows the copilot's MADC interface. The copilot's system is identical to the pilot's system, with the following exceptions:

- The ARINC 429 No. 1 output connects to IAC No. 2 primary MADC input.
- The ARINC 429 No. 2 output connects to IAC No. 1 secondary MADC input.
- The ARINC 429 No. 3 output connects to the RCZ-851E COM unit No. 2 primary input.

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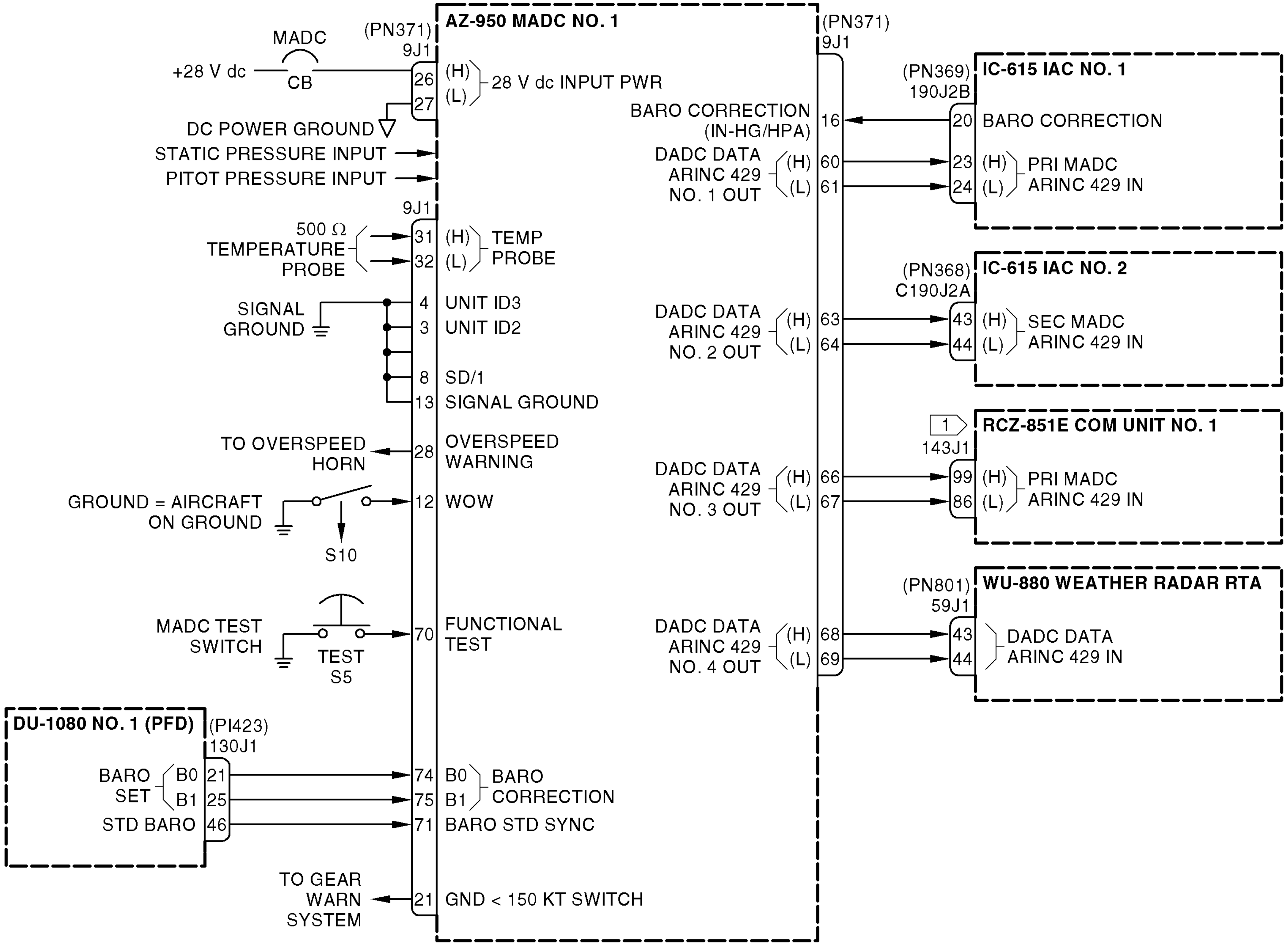

NOTE:

1 Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).

Figure 2-2-2. Pilot's MADC Interface

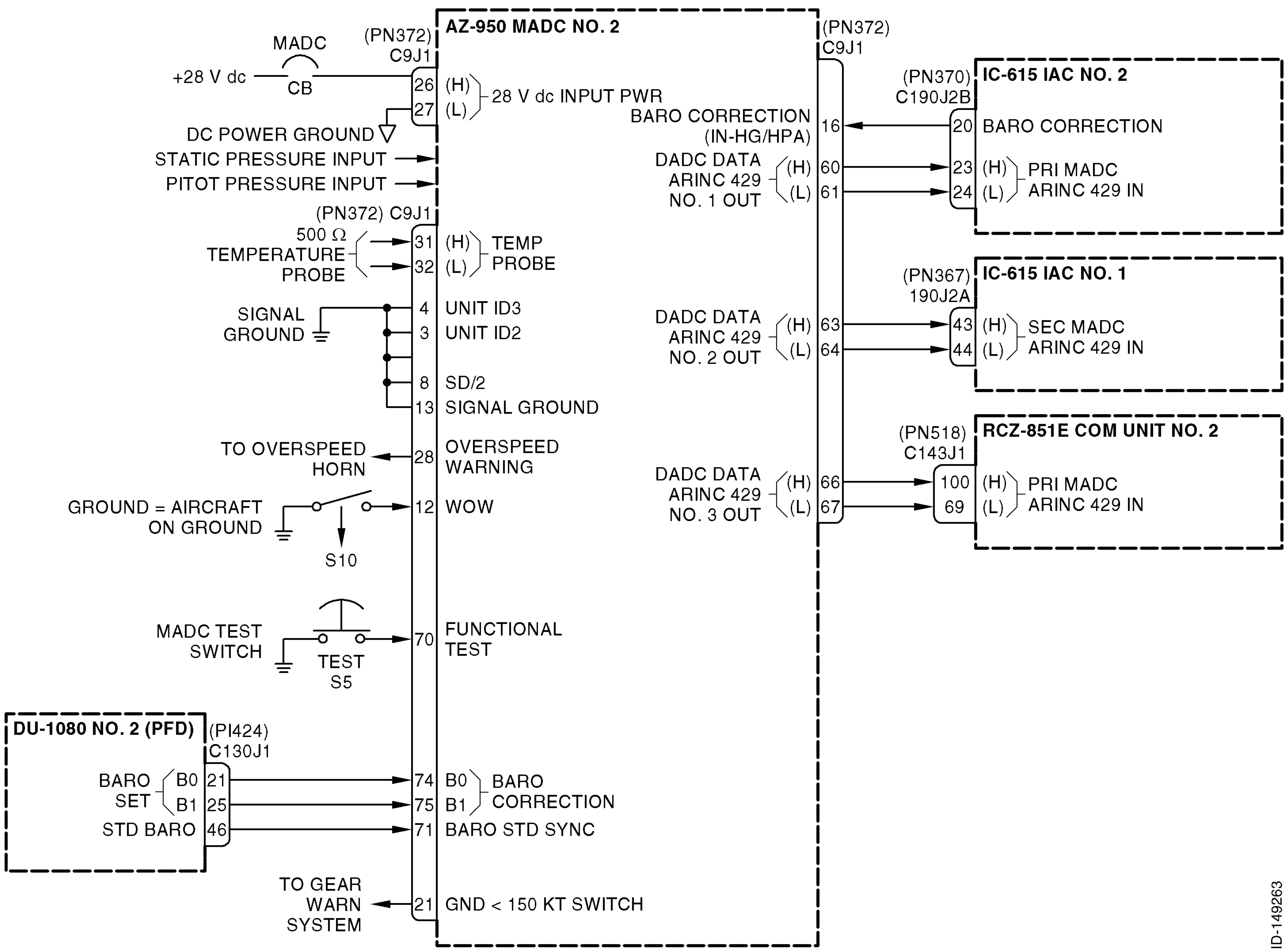

Figure 2-2-3. Copilot's MADC Interface

C. Modes of Operation

(1) The AZ-950 MADC has three operating modes:

- Normal
- Initiated test mode
- Maintenance test mode.

(2) The normal mode is for normal aircraft operation.

(3) The initiated test mode is activated by setting the maintenance panel to test. This test is interlocked with the WOW switch and is inhibited when airspeed is greater than 50 knots. In the initiated test mode, the MADC outputs are driven to preset values to check the operation of the MADC, interconnects, and displays.

(4) The maintenance test mode displays maintenance pages on the PFD while on the ground (WOW).

(5) Refer to Table 2-2-2 and Table 2-2-3 for performance accuracy and MADC self-test output data.

Table 2-2-2. AZ-950 MADC Performance Accuracy

Parameter	Range	Accuracy	SSEC
Barometric altitude	-1,000 to 60,000 ft	From -1,000 ft to sea level: ±15 ft From sea level to 20,000 ft: ±20 ft From 20,000 ft to 30,000 ft: ±40 ft From 30,000 ft to 50,000 ft: ±80 ft From 50,000 ft to 60,000 ft: ±150 ft	Yes
Altitude rate	±20,000 ft/min	±30 ft/min or ±5% (largest)	Yes
Mach	0.380 to 0.99	Variable from ±0.003 to ±0.050 Mach depending on speed and altitude	Yes
Computed airspeed	30 to 500 knots	From 30 to 60 knots: ±5 knots At 80 knots: ±3 knots From 100 to 200 knots: ±2 knots At 500 knots: ±5 knots	Yes
True airspeed	50 to 599 knots	At 50 knots: ±12 knots At 70 knots: ±8 knots From 150 to 599 knots: ±4 knots	Yes
Static air temperature	-99 to + 60 °C	±1 °C	No
Total air temperature	-78 to +99 °C	±1 °C	No
Baro corrected altitude	-1,000 to 60,000 ft	±5 ft or 0.5% (largest)	No
Baro correction	541 to 1083 hPa 16.0 to 32.0 inHg	± 1.0 hPa ± 0.01 inHg	No

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Table 2-2-3. MADC Functional Test Outputs

Parameter	ARINC 429 Value
Pressure altitude	4,000 ft
Baro corrected altitude	1,000 ft
Altitude rate	5,000 ft/min
Calibrated airspeed	325 knots
True airspeed	325 knots
Mach	0.77
Static air temperature	-45 °C
Total air temperature	-16 °C
Baro correction inHg	29.921 inHg
Baro correction mB	1013.0 mB
Static pressure	29.92 inHg
Total pressure	1013.2 mB
Impact pressure	181.8 mB
Vmo	320 knots
Vmo warning	Active for 2 seconds
MADC valid	Inactive
Output discretes	Active

D. MADC Monitoring

(1) A nonvolatile memory stores any in-flight monitor trips for on-the-ground analysis. This memory is accessed through the aircraft test connector.

(2) Built-in monitoring routines include tests to ensure the following:

- All program memory is addressable and readable.
- Pressure sensor outputs are in the correct range.
- The aircraft electrical keying is correct.
- Power supply outputs are of the correct values.
- The inputs to the MADC are reasonable.
- The central processing unit is functioning properly.

E. SSEC

(1) SSEC refers to a correction to account for errors that are long term, measurable, and repeatable. Typical static sensing systems are built as flush openings in the side of the aircraft, or as a protruding probe. The airflow past the static port causes the pressure in the static system to be different from the undisturbed air.

(2) A pressure error is caused by anything that causes a variation in the airflow as it passes the static port. Examples are as follows:

- Airflow around the curved fuselage
- Landing gear extended
- Position of flaps
- Aircraft yawing motion
- Angle of attack changes.

F. Operational Range

(1) The AZ-950 MADC is capable of supplying airspeed and altitude data over the ranges specified as follows:

- Altitude from -1,000 to 60,000 ft
- Indicated airspeed from 40 to 450 knots
- True airspeed from 50 to 599 knots.

G. Overspeed Warning

(1) During the normal mode of operation, overspeed warning is a signal to the pilot when the CAS output has exceeded the current value of Vmo. Overspeed warning function in the functional test mode is to illustrate that the warning signal operates correctly.

(2) The AZ-950 MADC computes the overspeed warning using calibrated airspeed, Mach, Vmo, Mmo, and pressure altitude. Overspeed warning is computed by comparing the pressure altitude with the break point in the Vmo/Mmo curve (see Figure 2-2-4). The break point is the point at which Vmo is constant or linear below and Mmo is constant or linear above. If pressure altitude is at or below the break point in the curve, then the CAS is compared to Vmo to switch overspeed warning on and off. If pressure altitude is above the break point in the curve, then Mach is compared to Mmo to switch overspeed warning on and off.

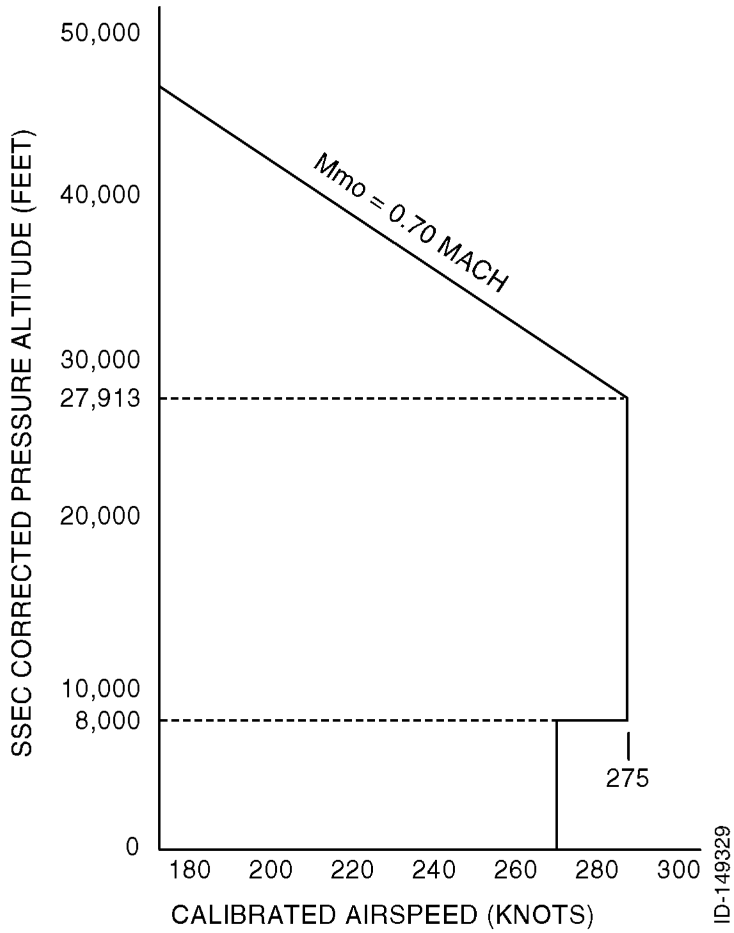

Figure 2-2-4. Vmo/Mmo Curve

4. Fault Monitoring

A. General

(1) Fault indications are presented on the PFDs and MFDs.

B. PFD

(1) Figure 2-2-5 shows the fault indications as presented on the PFD. The MADC faults displayed on the PFD are as follows:

(2) If barometric altitude is invalid:

- The digits, ticks, and chevrons on the altitude tape are removed and a red **X** is placed over the tape.
- The selected altitude digits are replaced with five amber dashes.
- The selected altitude bug is removed.

(3) If indicated airspeed is invalid:

- The digits and ticks on the airspeed tape are removed and a red **X** is placed over the tape.
- The airspeed trend vector is removed.
- The Vspeed bugs, if selected, are removed.
- The selected airspeed bug and digital readout is removed.

(4) If vertical speed (altitude rate) is invalid:

- The vertical speed pointer and digital readout are removed.
- The vertical speed target bug and digital display are removed.
- A boxed VS is displayed vertically in the center of the vertical speed arc.

Figure 2-2-5. PFD MADC Failure Indications

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C. MFD

(1) Figure 2-2-6 shows the fault indication as presented on the MFD. The MADC faults displayed on the MFD are the same for the map and plan formats.

(2) If TAS is invalid, the digits are replaced with three amber dashes.

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Figure 2-2-6. MFD Map Mode MADC Failure Indications

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SECTION 2-3
PRIMUS 880 WEATHER RADAR SYSTEM

1. Overview

A. General

(1) The PRIMUS 1000 Integrated Avionics System installed in the Cessna Citation XLS aircraft includes the PRIMUS 880 weather radar system made up of one WU-880 weather radar RTA, one WC-880 weather radar controller, and parts of the EDS. Each system is an X-band digital radar designed for weather location and analysis, and for ground mapping.

(2) The radar system detects precipitation in storms along the flightpath and a zone 60 degrees left and right of the center line of the aircraft. It gives the flightcrew a visual indication (in color) of storm intensity and turbulence. In the weather detection mode (WX), target returns are displayed at one of five video levels (0, 1, 2, 3, or 4), with 0 represented by a black screen because of weak or no returns, and levels 1, 2, 3, and 4 represented by green, yellow, red, and magenta respectively, to show progressively stronger returns. Areas of potential hazardous turbulence are shown in gray-white.

(3) The GMAP mode enables the pilot to identify coastline, hilly or mountainous regions, cities, or large structures. The reflected signal from various ground surfaces is displayed as magenta, yellow, or cyan (most to least reflective).

(4) The radar information can be displayed on the PFDs and/or the MFD. The radar range, operating mode, and antenna tilt functions are all controlled by the WC-880 weather radar controller.

2. Component Descriptions and Locations

A. WU-880 Weather Radar RTA

(1) Figure 2-3-1 shows a graphical view of the WU-880 weather radar RTA. The RTA is located in the avionics nose bay of the aircraft. Table 2-3-1 gives leading particulars for the RTA.

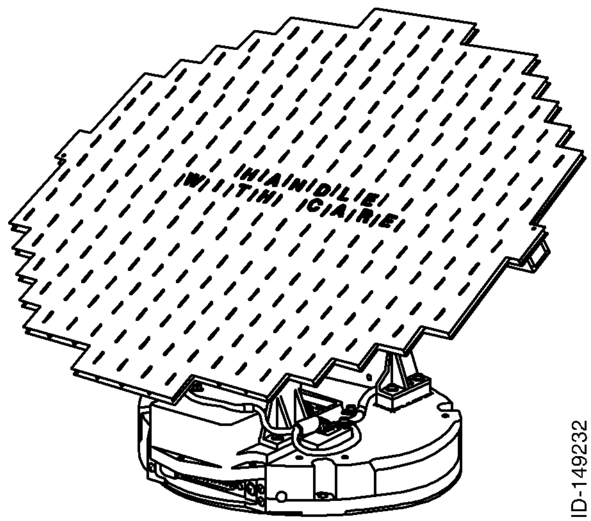

Figure 2-3-1. WU-880 Weather Radar RTA

Table 2-3-1. WU-880 Weather Radar RTA Leading Particulars

Item	Specification
Dimensions (maximum):	
• Base diameter	10.04 in. (255.0mm)
• Height (antenna flat)	10.06 in. (255.5 mm)
• Height (antenna full arc)	16.04 in. (407.4 mm)
Weight (maximum)	15.7 lb (7.12 kg)
Primary power	+22 to +32 V dc, 110 W (max)
Antenna:	
• Size	12 in. flat-plate radiator
• Stabilization	Line-of-sight, ±30 degrees
• Tilt	±15 degrees
• Scan (full)	120 degrees (±60 degrees)
• Scan (sector)	60 degrees (±60 degrees)
Transmitter:	
• Frequency	9375 ±25 MHz
• Power	10 kW (nominal), magnetron

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Table 2-3-1. WU-880 Weather Radar RTA Leading Particulars (cont)

Item	Specification
• Pulse width	1.0 and 2.0 μs (nominal) determined by selected range and mode
• Pulse repetition frequency (PRF)	180, 360, and 480 Hz, determined by selected range and mode
Receiver:	
• Noise figure	8.5 dB, typical
• Intermediate frequency (IF)	35 MHz
• IF bandwidth	0.8 MHz (nominal)
• Video bandwidth	Commensurate with selected pulse width
• Sensitivity time control (STC)	Present in all modes
• Minimum discernible signal (MDS)	-112.4 dBm (nominal) on 300 NM range
Receiver:	
• IF	60 MHz, 1st conversion 10.7 MHz, 2nd conversion
• IF bandwidth	0.725 MHz (nominal)
• Video bandwidth	Commensurate with selected pulse width
• STC	Present in all modes
• MDS	-115 dBm (nominal) on 300 NM range
Displayed ranges:	
• WX/MAP	5, 10, 25, 50, 100, 200, and 300 NM full scale with three concentric range rings (cyan for WX, green for MAP)
• Flight plan	5, 10, 25, 50, 100, 200, 300, 500, and 1000 NM full scale
• Turbulence mode	5, 10, 25, and 50 NM
User replaceable parts	None
Mating connector	Glenair Part No. DD104F1000, HPN 7517883-3

(2) The RTA is an integrated unit that incorporates receiver, transmitter, and antenna into a single unit. A 12-inch flat-plate radiator is used on the Cessna Citation XLS aircraft. The remainder of the circuitry is contained in the electronics package that forms the RTA base. Another feature of the base is a scan switch and a transmit ON/OFF switch for ease of adjustments during installation and maintenance.

(3) Elevation and azimuth drive motors, pitch and roll potentiometers, and associated electronics are mounted on the pedestal that holds the antenna. An electrical connector on the pedestal is the sole electrical interface with aircraft primary power and the rest of the radar system. The RTA operates from the aircraft 28 V dc power bus. The RTA is cantilever-mounted on the forward bulkhead in the nose of the aircraft, behind the radome fabricated to the operating frequency of the radar system.

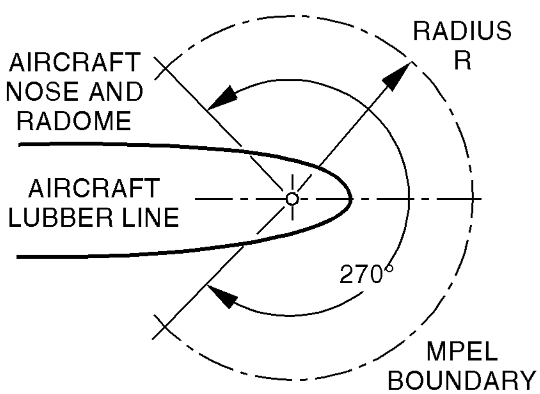
(4) The weather radar receives ARINC 429 data from the ARINC No. 3 output bus of the AHRS for weather radar antenna stabilization.

WARNING: WHEN THE RADAR SYSTEM IS ON, DO NOT GET CLOSER THAN THE MAXIMUM PERMISSIBLE EXPOSURE LEVEL (MPEL) RADIUS OF THE ANTENNA. MAKE SURE YOU KNOW THE MPEL RADIUS FOR YOUR SYSTEM, AND OBEY APPROVED SAFETY STANDARDS TO PREVENT INJURY TO PERSONNEL.

(5) Heating and radiation effects of weather radar can be hazardous to life. Personnel should remain at a distance greater than the radius (R) (Figure 2-3-2) from the radiating antenna in order to be outside of the envelope in which radiation exposure levels equal or exceed 10 mW/cm2, the limit recommended in FAA Advisory Circular AC No. 20-68B, August 8, 1980, Subject: Recommended Radiation Safety Precautions for Ground Operation of Airborne Weather Radar. The radius (R) to the MPEL boundary is calculated for the radar system on the basis of radiator diameter, rated peak-power output, and duty cycle. The greater of the distances calculated for either the far-field or near-field is based on the recommendations outlined in AC No. 20-68B.

(6) The American National Standards Institute (ANSI) in their document ANSI C95.1-1982, recommends an exposure level of no more than 6 mW/cm2.

(7) Honeywell recommends operators follow the 6 mW/cm2 standard. Figure 2-3-2 shows MPEL for 6 mW/cm2 exposure levels.



DIAMETER OF FLAT-PLATE RADIATOR	10 mW/CM ² RADIUS R OF MPEL BOUNDARY	6 mW/CM ² RADIUS R OF MPEL BOUNDARY
12IN / 30.5 CM	6 FT / 183 CM	7.5 FT / 275 CM

ID-149264

Figure 2-3-2. MPEL Boundary

WARNING: DO NOT OPERATE THE RADAR SYSTEM LESS THAN 100 FEET FROM OTHER AIRCRAFT OR OBJECTS. THIS WILL HELP PREVENT INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

(8) Danger from ground operation of airborne weather radar includes the possibility of human body damage and ignition of combustible materials by radiated energy. If the radar is to be operated in any mode other than standby (SBY) while the aircraft is on the ground, the following precautions are recommended:

(a) Direct nose of aircraft so the antenna scan sector is free of large metallic objects, such as hangars or other aircraft for a distance of 100 ft and tilt antenna fully upwards.

(b) Avoid operation during refueling of aircraft or other refueling operations within 100 ft.

(c) Avoid operation if personnel are standing within range as specified in Figure 2-3-2 in the 270 degrees forward sector of the aircraft.

B. WC-880 Weather Radar Controller

(1) Figure 2-3-3 shows a graphical view of the WC-880 weather radar controller. The controller is located on the pedestal in the cockpit of the aircraft. Table 2-3-2 gives leading particulars for the controller.

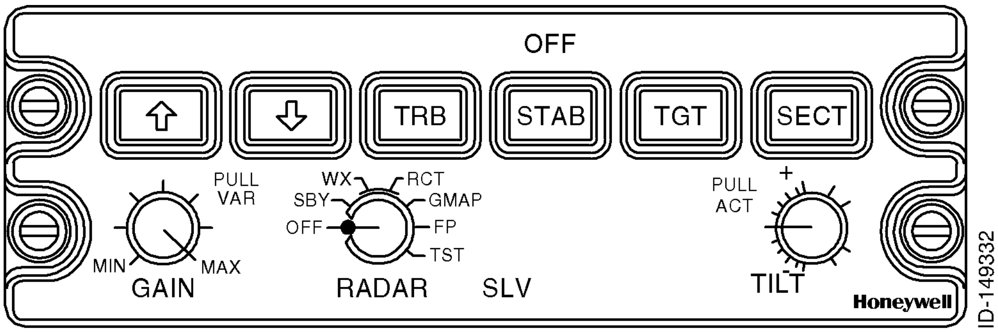


Figure 2-3-3. WC-880 Weather Radar Controller

Table 2-3-2. WC-880 Weather Radar Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.875 in. (47.63 mm)
• Width	5.75 in. (146.05 mm)
• Length (from back of mounting plate)	7.00 in. (177.80 mm)
Weight	2.0 lb (0.91 kg)
Power requirements:	
• Primary	28 V dc, 0.15 A (0.2 A maximum @ 20 V (20 V dc minimum to 33 V dc maximum)
• Panel lighting	5 V ac or dc, 2 A 28 V dc, 0.6 A
User replaceable parts:	
• Knob, gain/tilt	HPN 7011875-903
• Knob, mode	HPN 7011875-904
• Setscrew (multispline, 2-56 x 1/8”, cup point)	HPN 2500148-64
Mating connector	Cannon Part No. KJ6F14A18SN or equivalent
Mounting	Standard Dzus rail

(2) The pilot uses the WC-880 weather radar controller to select the modes, range, and antenna tilt. The radar information is displayed on the PFD and/or MFD. Knob and button selections on the controller are processed, converted to digital format, and transmitted to the RTA. The controller is panel mounted on Dzus rails with four one-quarter turn fasteners.

(3) The controller interfaces with the RTA through an enhanced serial control interface (ESCI) bus. Data representing knob and switch selections are encoded in either two's complement fractional binary notation or binary coded decimal notation, and transmitted to the RTA. The bus is connected by a shielded, twisted wire pair that carries data in one direction only. ESCI bus transmissions are made up of words, which are made up of three bytes of serial information. The first byte is called the (octal) label, which identifies the type of data contained within the word; the second and third bytes are the data. There are eight labels (A0 thru A7) and 24 bytes of data. These words are updated and transmitted every 60 ms. Bit number 1 is always the first bit transmitted, and bit number 7 is always the last bit transmitted.

(4) The weather radar controller function of each knob and button control is given in the paragraphs that follow.

(5) RADAR Knob

(a) The RADAR knob is a seven-position rotary knob that selects the primary radar modes as follows:

(b) OFF

1 This mode turns the radar system off.

(c) SBY

1 This mode puts the system in standby mode, ready state, antenna scan stopped, transmitter inhibited, and display memory erased. STBY is displayed on the electronic flight instrument system (EFIS)/MFD.

(d) WX

1 This mode puts the system in the weather detection mode. The system is fully operational and all internal parameters are set for enroute weather detection.

(e) RCT

1 This mode enables the cyan background REACT field to indicate ranges the receiver calibration has been exceeded in WX mode. RCT is selected in the TST mode on alternate sweeps automatically. RCT compensation is active in all modes except GMAP.

(f) GMAP

1 This mode puts the system in ground map mode, and the RCT compensation is inactive. The system is fully operational and all parameters are set to enhance returns from ground targets.

(g) FP

1 This mode put the system in the flight plan (navigation) display mode, which clears the screen of radar data so that ancillary data can be displayed. Examples of this are navigation displays and lightning discharge data. In FP mode the RTA is put in standby, alphanumerics are changed to to cyan, and the flight plan legend is displayed in the mode field.

(h) TST

1 This mode puts the system in the self-test mode. A special test pattern is displayed to verify system operation. In test mode, the RTA in on and transmitting X-band microwave energy unless the system has been put into forced standby mode.

(6) Gain Knob

(a) This is a single-turn rotary control and push/pull knob that varies the RTA receiver gain. When pushed, receiver gain is preset and calibrated. Calibrated gain is the normal mode used for weather avoidance. When active (pulled), the system enters the variable gain mode. Variable gain mode is useful for additional weather analysis and ground mapping. In the WX mode, variable gain can increase receiver sensitivity over the calibrated level to show weak targets, or it can be reduced below the calibrated level to eliminate weak returns.

(7) TILT Knob

(a) This is a single-turn rotary knob that selects the tilt angle of the antenna beam with relation to the horizon. CW rotation tilts the antenna beam upwards 0 to 15 degrees. CCW rotation tilts the antenna beam downwards 0 to -15 degrees. The range between +5 degrees and -5 degrees is expanded for ease of setting ability. The digital value of the tilt angle is displayed on the EFIS.

(b) When the TILT control is pulled out, the system engages the altitude compensated tilt (ACT). In ACT, the antenna tilt is automatically adjusted with regard to the selected range and barometric altitude. The antenna tilt automatically readjusts with changes in altitude and/or selected range. In ACT, the tilt control can fine tune the tilt setting by ±2.0 degrees.

(8) TRB Button

(a) The TRB button is used to select the turbulence detection mode. The TRB mode can only be selected if the RADAR knob is in the WX or RCT positions and the selected range is 50 miles or less. Areas of at least moderate turbulence are displayed in soft white. The turbulence threshold is 5 meters per second. Selecting 100, 200, or 300 miles range turns off turbulence detection. Subsequent selection of ranges of 50 miles or less re-engages turbulence detection.

(9) STAB Button

(a) The STAB button turns the pitch and roll stability on and off. It is also used with the STAB adjust mode to override forced standby.

(10) TGT button

(a) The TGT button is an alternate action button that enables and disables the target alert function. Target alert is selectable in all but the 300-mile range. When selected, the target alert monitors beyond the selected range and 7.5 degrees on each side of the aircraft heading. If a return is detected with certain characteristics is detected in the monitored area, the target alert changes from the green armed condition to the yellow TGT warning condition. This annunciator advises the pilot that a potentially hazardous target lies directly in front and outside of the selected range. Selecting TGT forces the system to a preset gain. TGT can only be selected in the WX and FP modes.

(11) SECT button

(a) The SECT (scan sector) button is used to select either the normal 12 looks per minute, 120-degree scan or the faster update 24 looks per minute, 60-degree scan.

(12) FSBY

(a) Forced standby is an automatic, nonselectable radar mode. As an installation option, the indicator can be wired to the WOW switch. When wired, the RTA is in the FSBY mode when the aircraft is on the ground. In FSBY mode, the transmitter and the antenna scan are both inhibited, display memory is erased, and the FSBY legend is displayed in the mode field. When in the FSBY mode, pushing the STAB button four times in 3 seconds restores normal operation. FSBY mode must be verified by the operator to ensure safety of ground personnel.

(13) SLV

(a) The SLV (slave) annunciator is used in dual-controller installations. With dual controllers, one controller can be slaved to the other by selecting OFF on that controller only with the RADAR knob. This slaved condition is annunciated with the SLV annunciator. In the slaved condition both controllers must be off before the radar system turns off.

3. Operation

A. Introduction

(1) The PRIMUS 880 weather radar system is an X-band digital radar designed for weather detection, analysis, and ground mapping. The display of this information is presented on the PFDs, the MFD, or a combination of these displays. With a single weather radar controller, all displays are identical.

(2) The weather radar RTA detects storms along the flightpath of the aircraft and gives the flightcrew a visual indication, in color, of storm intensity. The WX detection mode displays rainfall intensity levels in bright colors against a black background. Areas of heaviest rainfall appear in magenta, significant rainfall is red, medium intensity rainfall is yellow, and weakest rainfall is green.

(3) The surface GMAP mode enables the pilot to identify coastline, hilly or mountainous regions, cities, or large structures. The reflected signal from various ground surfaces is displayed as magenta, yellow, or cyan (most to least reflective).

(4) The weather radar controller selects the radar operating mode and controls the antenna tilt by rotary switches on the controller.

(5) There are six modes of operation on the the PRIMUS weather radar system as follows:

- Standby
- Weather
- REACT
- Ground mapping
- Flight plan
- Test .

(6) The PRIMUS 880 weather radar system incorporates features such as target alert and turbulence.

B. Weather Radar System Functions

(1) The WC-880 weather radar controller selects the modes, range, and antenna tilt. The radar information is displayed on the PFD and/or MFD. Knob and button selections on the controller are processed, converted to digital format, and transmitted to the RTA. The function of each switch and control of the controller is described in paragraph 2.B.

(2) The RTA accepts mode, tilt, etc., commands from the controller on a serial control bus. The RTA outputs mode, range, tilt, etc., commands to the IACs on two EDS control buses, and outputs scan-converted data to the DUs on two EDS picture buses. Antenna stabilization data is input from the AHRS over the ARINC 429 bus.

(3) Modes of Operation

(a) On power-up, the system automatically comes on in standby. When power is first applied, the radar is in WAIT for 45 to 90 seconds, allowing the magnetron to warm up.

(b) Standby (SBY)

1 Standby is used for keeping the radar in a ready state while taxiing, loading, etc. In SBY, the antenna does not scan, the transmitter is disabled, the display memory is erased, and the antenna is stowed in a tilt-up position. SBY can be selected anytime it is desired to keep power on the system without transmitting.

2 The system contains a forced standby function. This permits the WOW button to force the radar into standby automatically. When this occurs, the FSBY mode is displayed. When the aircraft is on the ground, the user may override it by pushing the STAB button four times within 3 seconds.

(c) Weather (WX)

1 Weather operation is selected by placing the controller RADAR knob to the WX position. If selected prior to the end of the warm-up period, WAIT is displayed until the transmitter warms up (approximately 45 to 90 seconds). WX is displayed in the mode field. Transmitter output power is radiated in the WX mode. In the WX mode, four precipitation levels are displayed, as given in Table 2-3-3.

Table 2-3-3. Target Intensity Levels

Display Level	Rainfall Rate (mm/hr)	Rainfall Rate (in/hr)	Storm Category
4 Magenta	Greater than 50	Greater than 2.0	Extreme/intense
3 Red	12 - 50	0.47 - 2.0	Strong
2 Yellow	4 - 12	0.16 - 0.47	Moderate
1 Green	1 - 4	0.04 - 0.16	Weak
0 Black	Less than 1	Less than 0.04	–

2 REACT (RCT)

a The REACT function permits the radar receiver to adjust its own sensitivity automatically to compensate for attenuation losses as the radar pulse passes through weather targets on its way to illuminate other targets. This is done by measuring the intensity of signals and deducing from them the density, and therefore the attenuation of the target, then using this information to adjust the sensitivity. This is done continuously on each radar azimuth radial. There is a maximum value to which sensitivity may be set, due to the receiver generating noise, and would fill the display with noise it it were too high. When this maximum value is reached, a cyan field is displayed for the remainder of the displayed range. This gives the pilot an unmistakable warning that attenuation is hiding possible severe weather areas that cannot be accurately detected.

b REACT is always selected in TEST mode. REACT is available in all modes except GMAP.

c Receiver sensitivity, even in the absence of targets, is gradually increased by the STC and the extended STC circuits with increasing range, to compensate for weakening of targets, due to simple distance. The REACT modifies this action.

3 Ground Mapping (GMAP)

a The ground-mapping operation is selected by setting the controller RADAR knob to the GMAP position. The TILT control is turned down until the desired amount of terrain is displayed. The degree down-tilt depends on the aircraft altitude and the selected range.

b The receiver STC characteristics are altered to supply equalization of ground-target reflection versus range. As a result, the selection of preset GAIN generally supplies the desired mapping display. However, the pilot may desire to decrease the gain manually by selecting variable gain and rotating the GAIN control knob.

c Ground mapping allows the pilot to interpret the color display patterns that indicate water regions, coast lines, hilly or mountainous regions, cities, and large structures. In GMAP mode, targets of increasing reflectivity are displayed as cyan, yellow, and magenta.

4 Flight Plan (FP)

a The flight plan mode of operation can be used with certain long-range navigation systems. If operational, setting the controller RADAR switch to the FP position displays the active flight plan from the LRN system. The maximum range and type of data displayed is dependent on the capabilities of the LRN system.

5 Test (TST)

a Test is used to select the special test pattern to give verification of system operation.

WARNING: WHEN THE WEATHER RADAR IS IN THE TEST MODE, DO NOT GET CLOSER THAN THE MAXIMUM PERMISSIBLE EXPOSURE LEVEL (MPEL) RADIUS OF THE TRANSMITTER. THE TRANSMITTER RADIATES X-BAND MICROWAVE ENERGY AND CAN CAUSE INJURY TO PERSONNEL. MAKE SURE YOU KNOW THE MPEL RADIUS FOR YOUR SYSTEM, AND OBEY APPROVED SAFETY STANDARDS.

b To inhibit the radar from radiating in the test mode, the XMTR ON switch on the RTA is placed off (toward the antenna). The radar is tested as normal; however, an amber FAIL message is displayed. To inhibit the radar antenna from scanning during test, the SCAN ON switch on the RTA is placed off (toward the antenna). The radar tests normally, but a SCAN FAIL message is displayed.

c Make sure that the XMTR ON and SCAN ON switches on the RTA are returned to their normal position (away from the antenna) for flight.

d With TST selected, 100-mile range is automatically selected, and TEST is displayed in the mode field. Transmitter output power is radiated in TEST mode, and any faults present are displayed.

(d) Turbulence (TRB)

1 With TRB selected, the radar processes return signals to determine if a turbulence signature is present. Areas of potentially hazardous turbulence are displayed as gray-white. The high power of the RTA permits detection of hazardous turbulence in areas of otherwise weakly reflective rainfall. TRB can only be engaged in the WX mode and in selected ranges of 50 NM or less.

(e) Stabilization (STAB)

1 STAB enables stabilization inputs to the antenna. Pitch and roll inputs to the antenna are provided so that the antenna beam is maintained at the selected tilt angle relative to the earth's surface. The OFF condition is annunciated above the button and in this condition, no inputs are provided for stabilization. The STAB button is also used to override forced standby by pushing it four times within 3 seconds.

(f) Target Alert (TGT)

1 Target alert is a selectable ON/OFF feature to monitor for level 3 or greater targets within an arc of ±7.5 degrees dead ahead. TGT is selectable in any WX range, except 300 NM. For a target to activate the target alert feature, it must have a depth and range characteristic as given in Table 2-3-4. Target alert forces the system to a preset gain and can only be selected in the WX and FP modes.

Table 2-3-4. Target Alert Range and Depth

Selected Range (NM)	Target Depth (NM)	Target Range (NM)
5	5	5 - 55
10	5	10 - 60
25	5	25 - 75
50	5	50 - 100
100	5	100 - 150
200	5	200 - 250
300	Disabled	-
FP (Flight Plan)	5	5 - 55

2 Sector Scan (SECT)

a Sector scan selects either full (120 degrees) or reduced (60 degrees) scan sector.

C. Mode and Warning Annunciations

(1) The PRIMUS weather radar system has a number of mode and warning annunciators. The location of the WX mode and warning annunciation display fields for the PFD and MFD are shown in Figure 2-3-5 and Figure 2-3-6. Table 2-3-5 gives a full description of the different mode and warning annunciators and their line locations, the top being line number 1 and the bottom being line number 4.

(2) If the weather radar RTA is transmitting, and WX is not selected for display on the PFD and/or MFD formats, the characters TX are annunciated. TX is not displayed if WX is in WAIT, STBY, or FSBY modes.

Table 2-3-5. PFD and MFD WX Mode and Warning Annunciators

Display			Mode Description
Annunciator	Color	Line No.	
WAIT	Green	1	Power-up approximately 1 minute
STBY	Green	1	Normal standby
FSBY	Green	1	Forced standby (WOW)
TEST	Green	1	Test mode and no faults
WX	Green	1	Normal WX on and selected for display
WX	Amber	1	Invalid weather radar control bus, invalid weather radar ranges
WX/T	Green	1	Normal WX with turbulence
TX	Magenta	1	Weather radar is transmitting but not selected for display and not in STBY, FSBY, WAIT, or FPLN
STAB	Amber	4	Stabilization off
TGT	Green	2	Target alert enable
TGT	Amber (flashing)	2	Target alert enabled and level 3 WX return detected in forward 15 degrees of antenna scan
VAR	Amber	2	Variable gain
RCT	Green	1	Normal WX with react
R/T	Green	1	WX with REACT and turbulence
GMAP	Green	1	Ground map mode
FPLN	Green	1	Flight plan mode
FAIL	Amber	1	Test mode and faults

D. Hidden Modes

(1) The PRIMUS 880 weather radar system has five hidden modes that are selected by special control operations. They are not intended for use in normal operations. These modes are given in Table 2-3-6.

Table 2-3-6. Hidden Modes

Mode	Function	Entry Method	Exit Method
Forced standby override	This function places the radar in a standby mode on the ground which prevents the radar from radiating. This is to protect ground personnel from the damaging effects of microwave energy exposure.	Power up the aircraft on the ground or land the aircraft with the radar powered.	Push the STAB button four times within 3 seconds.
Roll offset	This permits exact compensation of the antenna roll to eliminate the effects of small errors in the aircraft radar installation. Constantly lopsided ground returns can be eliminated.	Using only one controller that is in the WX variable gain mode, select RCT off. Push STAB four times within 3 seconds. Verify that VAR and RCT are not displayed. The GAIN control adjusts the roll offset.	Push the STAB button once to continue with the next adjustment.
Roll gain	Roll gain corrects the installation at bank angles over 20 degrees for nonsymmetrical displays.	Selected by sequencing through the roll offset and pitch menus with the STAB button. The GAIN control adjusts the roll gain.	Push the STAB button once to continue with the next adjustment.
Pitch offset	Pitch offset adjusts the pitch attitude of the antenna so that in straight and level flight radar returns conform to the radar range rings.	Selected by sequencing through the roll offset and pitch menus with the STAB button. The GAIN control adjusts the roll gain.	Push the STAB button once to continue with the next adjustment.

Table 2-3-6. Hidden Modes (cont)

Mode	Function	Entry Method	Exit Method
Pitch gain	Pitch gain adjusts the gain if the radar display is in pitch so that the contour lines track the range lines at higher pitch attitudes.	The GAIN control adjusts the pitch gain.	Push the GAIN control in. Push the STAB button to exit and save settings.

NOTES:

1. If installation is configured for only roll offset adjustment, pushing the STAB button saves and exits after the roll adjustment is made.
2. Upon exiting, stabilization may be either off or on depending upon how many times it was pushed during the procedure. Be sure that the stabilization is set to off or on as desired.
3. If no changes are desired upon entering the adjustment mode, keep the GAIN control pushed in while repeatedly pushing the STAB button until the mode is exited.

E. PRIMUS 880 Weather Radar Interface Diagram

(1) See Figure 2-3-4 for PRIMUS 880 weather radar interface diagram information.

(2) Left-side IC-615 IAC

(a) The IAC receives a two-wire, 1-MHz, serial bus input of display data from the RTA for display.

(3) Right-side IC-615 IAC

(a) The IAC receives a two-wire, 1-MHz, serial bus input of display data from the RTA for display.

(4) WC-880 Weather Radar Controller

(a) The controller supplies all of the control inputs for the weather radar system.

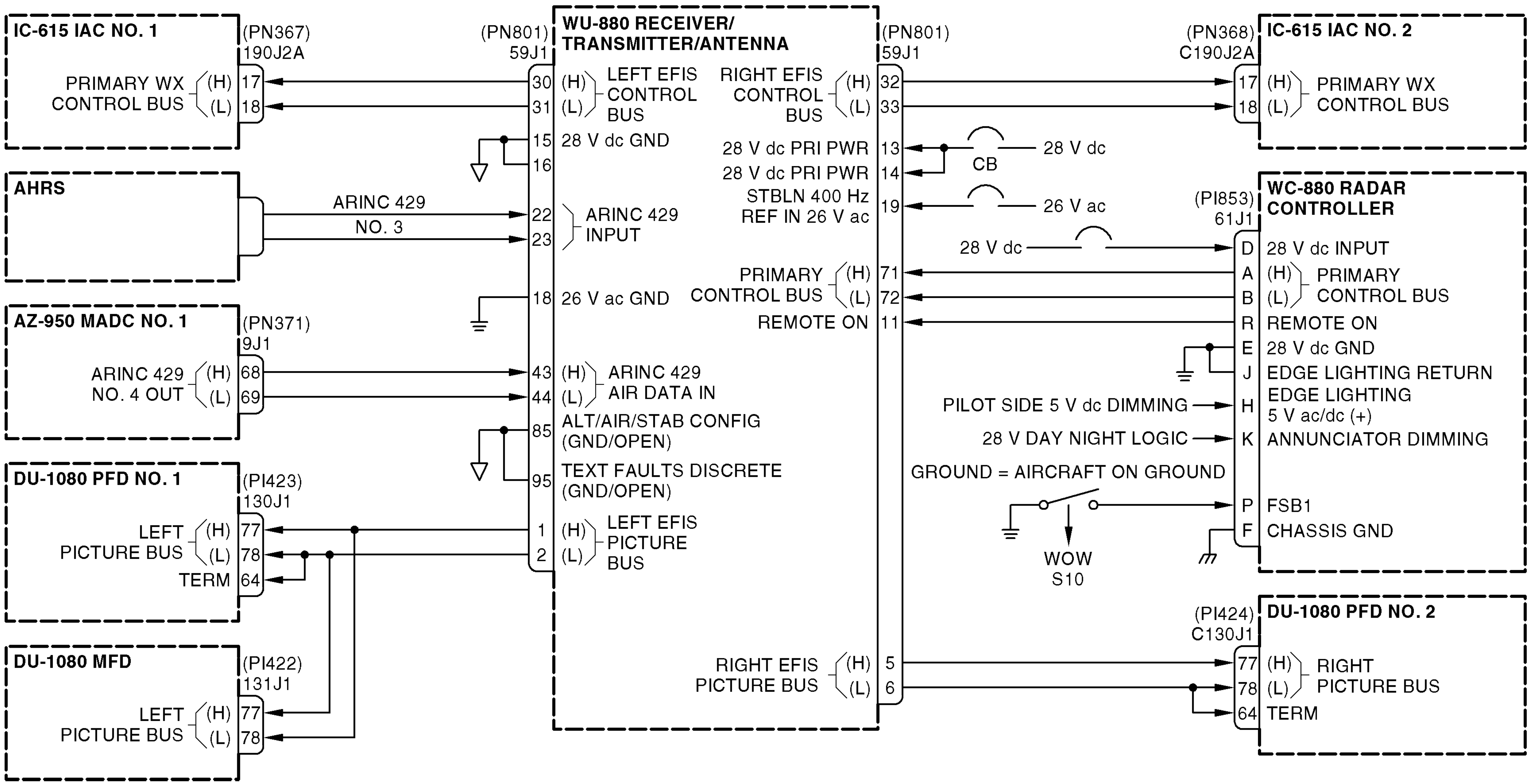


Figure 2-3-4. PRIMUS 880 Weather Radar System Interface Diagram

4. Fault Monitoring

A. General

(1) Fault indications are presented on the PFDs and MFDs.

B. PFD

(1) Figure 2-3-5 shows the fault indication as presented on the PFD. Weather radar failure, regardless of the display format (FULL/ARC/WX), annunciates an amber WX on the lower left side of the HSI on the PFD.

C. MFD

(1) Figure 2-3-6 shows the fault indication as presented on the MFD. Weather radar failure annunciates an amber WX on the lower left side on the MFD.

Figure 2-3-5. PFD Weather Radar Failure Indication

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Figure 2-3-6. MFD Weather Radar Failure Indication

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D. PRIMUS 880 Weather Radar Test Mode

(1) The PRIMUS 880 weather radar system supplies fault information on one of two formats as follows:

- Fault codes
- Text codes.

(2) The selection is made during initial system installation.

(3) When a fault occurs (either in-flight or on-ground), an amber WX overrides the mode annunciation on the PFD and/or MFD. The fault annunciator remains until the fault condition clears.

(4) If fault annunciation occurs, the flightcrew should select the test mode and note the displayed text fault or fault code and take appropriate action.

(5) Figure 2-3-7 shows the PRIMUS 880 MFD weather radar test mode, and Table 2-3-7 gives the PRIMUS 880 fault codes and fault descriptions.

(6) On-Ground TEST Display (With TEXT FAULTS Enabled)

(a) When TEST is initiated on the ground (WOW asserted), six fields are displayed as shown in Figure 2-3-7.

(b) The six fields are as follows:

- Pilot message field (e.g., STAB UNCAL)
- Line maintenance message (e.g., CHK ATT SRC)
- Fault code/power-on count (e.g., CODE:27 POC:0)
- Fault name (e.g., NO STAB SRC)
- Xmit on/off (e.g., XMIT ON!)
- Strap code (e.g., 1F1BB:STRAPS).

(c) Faults (up to 32) from the last 10 power-on cycles are cycled every two antenna sweeps (approximately 8 seconds). A fault is displayed only if it occurred within the last 10 power-on cycles and is among the 32 most recent faults to have occurred.

(d) POC=0 is the current power-on cycle, POC=1 is the last power-on cycle, -2 is 2 power-on cycles ago, etc.

(e) Upon entering TEST mode, if there are no currently active faults, a RADAR OK message is displayed for one sweep. After that, the most recent fault is displayed, cycling to the oldest fault in the eligible list of faults. Upon reaching the last fault, an END OF LIST message is displayed. To recycle through the list again, exit and re-enter the TEST mode.

(f) Input-type faults (NO STAB SRC, NO AIRSPEED, NO ALTITUDE, etc.) are displayed, but not logged, on-ground.

(7) In-Flight TEST Display (With TEXT FAULTS Enabled)

NOTE: The radar is transmitting when TEST is initiated while in-flight.

(a) If the WOW input is not asserted, only the fields that follow are displayed:

- Pilot message field (e.g., RADAR UNCAL)
- Line maintenance message (e.g., PULL RTA)
- Fault code.

(b) Only currently active (not cleared) faults are displayed in-flight.

(8) Fault Monitors

(a) Critical functions in the RTA are continuously monitored. Each fault condition has a corresponding fault code (FC). Additionally, a fault name, a pilot message, and a line maintenance message are associated with each fault condition. These are shown in Table 2-3-7.

(b) The fault name describes which fault has been detected.

(c) The pilot message advises the flightcrew how to respond to a fault when it occurs in-flight. This can include checking other systems, or to use caution when interpreting certain data displayed, and/or to advise that a minor function such as ACT is unavailable.

(d) The line maintenance message advises the ground crew on a suggested action to take, or which LRU(s) to suspect.

(e) The XREF code is a four-bit Central Aircraft Information Maintenance System (CAIMS) fault code. This code is not visible to the flightcrew. It is used only on aircraft with a CAIMS installed.

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Figure 2-3-7. PRIMUS 880 MFD Weather Radar Test Mode Indications

Table 2-3-7. PRIMUS 880 Fault Codes

FC	XREF	Fault Description	Fault Name	Pilot Message	Line Maintenance	Fault Type
1	4808	STARTUP CODE CRC	FLASH CRC	RADAR FAIL	PULL RTA	POWER ON
	4809	IOP CODE CRC				
	4810	DSP CODE CRC				
	4904	CONFIG TABLE CRC				
	4905	FPGA FIRMWARE CRC				
2	4846	2V ADC REFERENCE	IOP	RADAR FAIL	PULL RTA	CONTINUOUS
	4903	IOP READY				POWER ON
	4908	INT ARINC 429 LOOPBACK				
	4913	INT ARINC 429 COUPLING				
3	4806	EEPROM TIMER CRC	FLASH CRC	RADAR FAIL	PULL RTA	POWER ON
	4842	STAB TRIM CRC	EEPROM	REDO STAB TRIM	REDO STAB TRIM	
	4912	CALIBRATION CRC	IOP	RADAR FAIL	PULL RTA	
4	4812	IOP MAILBOX	MAILBOX RAM	RADAR FAIL	PULL RTA	POWER ON
	4818	DSP MAILBOX				
5	4813	TIMING FPGA RAM	FPGA	RADAR FAIL	PULL RTA	POWER ON
	4814	TIMING FPGA REG				
	4815	IO FPGA				
	4828	FPGA DOWNLOAD				
	4906	IO FPGA REG				
6	4847	STC MONITOR	STC DAC	RADAR FAIL	PULL RTA	POWER ON
7	4830	HVPS MONITOR	HVPS MON	RADAR FAIL	PULL RTA	CONTINUOUS

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Table 2-3-7. PRIMUS 880 Fault Codes (cont)

FC	XREF	Fault Description	Fault Name	Pilot Message	Line Maintenance	Fault Type
	4816	DSP RAM				
	4817	DSP VIDEO RAM				POWER ON
10	4855	DSP WATCHDOG				CONTINUOUS
	4900	MAILBOX MISCOMPARE	DSP	RADAR FAIL	PULL RTA	
	4901	DSP HOLDA ASSERTED				POWER ON
	4902	DSP HOLDA NOT ASSERTED				
	4825	FILAMENT MONITOR				
11	4827	SEVERE MAGNETRON	MAGNETRON	RADAR FAIL	PULL RTA	LATCHED
	4829	PFN TRIM MONITOR	HVPS MON			CONTINUOUS
13	4832	ELEVATION ERROR	EL POSITION	TILT UNCAL	CHK RADOME/RTA	CONTINUOUS
14	4833	AZIMUTH ERROR	AZ POSITION	TILT UNCAL	CHK RADOME/RTA	CONTINUOUS
15	4836	OVER TEMP	OVER TEMP	RADAR CAUTION	PULL RTA	CONTINUOUS
16	4837	XMITTER POWER	XMTR POWER	RADAR UNCAL	PULL RTA	CONTINUOUS
	4839	NO SCI CONTROL				
20	4911	NO ARINC 429 CONTROL	NO CNTL IN	CHK CNTL SRC	CHK CNTL SRC	PROBE
	4840	AGC LIMITING		PICTURE UNCAL		CONTINUOUS
21	4927	AGC RX DAC MONITOR	AGC		PULL RTA	
	4928	AGC TX DAC MONITOR		RADAR FAIL		POWER ON
22	4841	SELFTEST OSC FAILURE	RCVR SELF TEST	PICTURE UNCAL	PULL RTA	CONTINUOUS
	4843	MULTIPLE AFC UNLOCKS				
	4845	AFC SWEEPING		SPOKING LIKELY		CONTINUOUS

Table 2-3-7. PRIMUS 880 Fault Codes (cont)

FC	XREF	Fault Description	Fault Name	Pilot Message	Line Maintenance	Fault Type
24	4929	AFC RX DAC MONITOR	AFC		PULL RTA	
	4930	AFC TRIM DAC MONITOR		RADAR FAIL		POWER ON
27	4848	AHRS SOURCE	NO STAB SRC	STAB UNCAL	CHK ATT SRC	INSTALLATION
	4852	ANALOG STAB REF				
30	4849	DADC AIRSPEED	NO AIRSPEED	TURB UNCAL	CHK ADC	INSTALLATION
	4932	AHRS GROUNDSPEED			CHK SPEED SRC	
33	4931	DADC ALTITUDE	NO ALTITUDE	NO ACT	CHK ADC	INSTALLATION
	4933	AHRS INERTIAL ALTITUDE			CHK ALT SRC	
34	4853	SCAN SWITCH OFF	SCAN SWITCH	SCAN SWITCH	CHK SWITCH	INSTALLATION
35	4854	XMIT SWITCH OFF	XMIT SWITCH	XMIT SWITCH	CHK SWITCH	INSTALLATION
36	4914	INVALID ALTITUDE/ AIRSPEED/STAB STRAPPING	INVALID STRAPS	RADAR UNCAL	CHK STRAPS	POWER ON
	4915	INVALID CONTROLLER SOURCE STRAPPING				
	4916	CONFIG1 DATABASE VERSION/SIZE MISMATCH	IOP	RADAR FAIL	PULL RTA	-

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SECTION 2-4
PRIMUS II INTEGRATED RADIO SYSTEM

1. Overview

A. General

(1) The PRIMUS 1000 Integrated Avionics System installed in the Cessna Citation XLS aircraft includes the PRIMUS II integrated radio system. It is a dual system, with system No. 1 on the left and system No. 2 on the right.

(2) The PRIMUS II integrated radio system is made up of two subsystems: the RCZ-851E integrated COM units and the RNZ-850 and RNZ-850B integrated NAV units, along with associated controls, displays, and antennas. The cockpit controls are made up of the RM-850 RMU, AV-850A audio panel, the CD-850 CDH, and the DI-851 DME indicator.

(3) The radio system provides COM and NAV information for the flightcrew. The NAV data is fed to the IAC for display on the EDS, and for use by the automatic flight control system (AFCS), both of which are resident within the IACs. NAV data is also fed to the FMS computer.

(4) The integrated radio system has a number of options that are selected by the installer by means of configuration straps. The strap options for the NAV and COM units are programmed on a strap assembly that is aircraft unique and is electrically connected to each unit. Strap options for the RMU and CDH are pin programmed on the unit mating connector. There is no pin programming in the audio system. Strap programming procedures are found in the AMM for the Cessna Citation XLS.

(5) The PRIMUS II integrated radio system standard installation is made up of the following LRUs:

- Two RM-850 RMUs
- One CD-850 CDH
- Two AV-850A audio panels
- Two RCZ-851E integrated COM units (VHF COM and ATCRBS)
- One RNZ-850 integrated NAV unit (VOR, ADF, and DME) - pilot's side
- One RNZ-850B integrated NAV unit (VOR and DME) - copilot's side
- Two DI-851 DME indicators
- One AT-860 ADF combined sense/loop antenna - left side.

2. Component Descriptions and Locations

A. RM-850 RMU

(1) Figure 2-4-1 shows a graphical view of a typical RM-850 RMU. The RMUs are located in the cockpit instrument panel of the of the aircraft. Table 2-4-1 gives leading particulars for the RM-850 RMU.

(2) The RMU is the central control unit for the entire radio system. It gives complete capability for controlling the operating mode, frequencies, and codes within all the units of the radio system. Additionally, the RMU has the capability to switch its operation from its primary radio system to the cross-side system. The RMU is a color cathode ray tube (CRT)-based controller that can select a function by pushing a line select key adjacent to the parameter to be changed. Any selectable parameter, such as VOR frequency, can be changed by pushing the corresponding line key next to the displayed parameter and then rotating the controller tuning knob. For some functions, additional pushes of the line select key toggles modes or recalls stored numbers.

(3) The RMU is also the input to the radio system for external FMS tuning. Digital signals from the FMS come into the RMU, where they act in much the same manner as if the front tuning knob were being operated. This allows the FMS to enter into the system in an organized manner, and appears to the system as if the flightcrew is tuning the receiver.

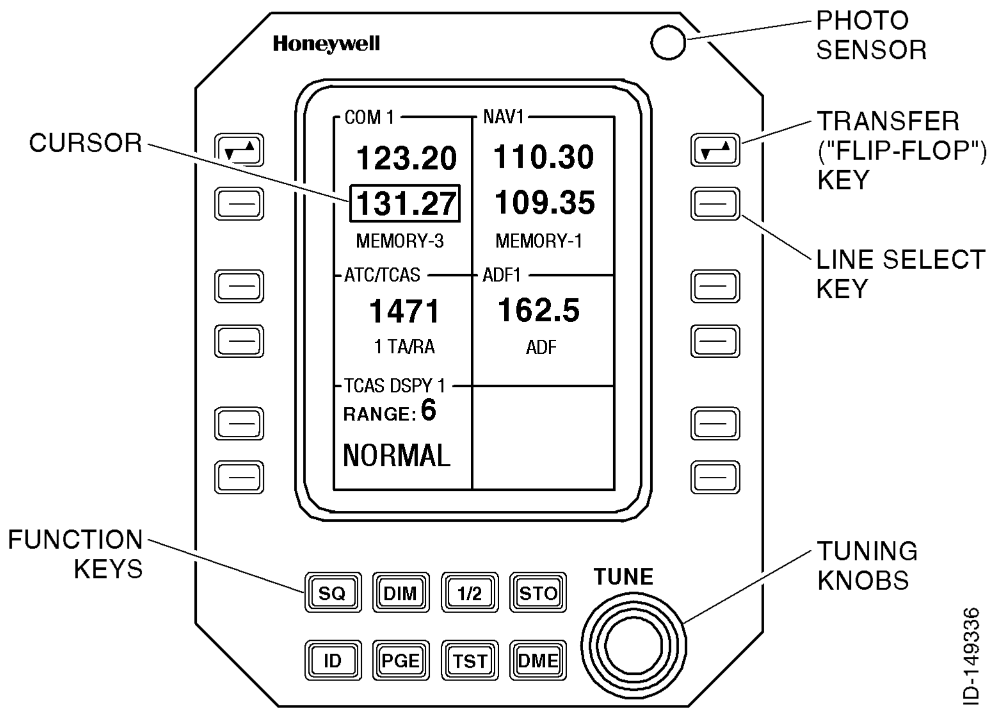

Figure 2-4-1. Typical RM-850 RMU

Table 2-4-1. RM-850 RMU Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	5.06 in. (128.5 mm)
• Width	4.06 in. (103.1 mm)
• Length	11.10 in. (281.9 mm)
Weight	7.2 lb (3.27 kg)
Power:	
• Nominal	+28 V dc, 33 W (max)
• Panel lighting	0-5 V ac/dc, 0.025 W (max)
User replaceable parts:	
• Knob, large	HPN 7012149
• Knob, small	HPN 7013773
• Setscrew, 4-40 x 1/8 in., cup point steel (4)	HPN 2500148-128
Mating connector	MS3126F20-41S
Mounting clamp	HPN 7000066-11

(4) Backup navigation data is provided to the RMU via the RSB from both remote NAV units, and/or via RS-422/CSDB data buses from whichever remote NAV unit is married to the CDH for emergency backup purposes.

(5) For ease of operation, the RMU screen is divided into windows. Each window groups the data associated with a particular function of the radio system. Each window (COM, NAV, ATC, ADF, and TCAS) displays the frequency and/or operating mode of the associated function. The RMU also has other display modes, called pages, which perform additional features and functions for the control of the radio system. The ATC/TCAS window formats are determined by the actual installation.

(6) Located on the front of the RMU is a button labeled PGE. Pushing the PGE button causes the RMU to toggle through different pages of the display. The normal five window display is called the main page and is always present under normal operation. The other pages are associated with preset memory location and operation for the NAV and COM windows. Further pages are available by a combination of control buttons and menus to enable the display of various maintenance data from within the radio system. If any page other than the main page is being displayed, the bottom left line select key is the return key. In all cases, pushing the return key changes the display back to the main page.

(7) When the TCAS II system is installed, the RMU windows are as shown in Figure 2-4-1. If TCAS II is not installed, both bottom windows can be disabled. This is done by first pushing the PGE key, pushing the key adjacent to MAINTENANCE, and pushing the key adjacent to RMU SETUP. On the RMU SETUP page, pushing the line select key at either end of DISPLAY toggles between ENABLED and DISABLED. Pushing the line select key at the lower left returns the display to the main page. This selection function is only available when WOW is true.

(8) The ATC FLIGHT ID function is designed for use by the airlines. In the Cessna Citation XLS, this function should be disabled. If it is inadvertently enabled, the Flight ID display line at the bottom of the transponder window on the main page is present.

(9) As with operation of the cursor in the COM and NAV windows, pushing the key adjacent to the upper half of the transponder window connects the TUNE knobs to the numbers (large knob = left two numbers, small knob = right two numbers).

(10) Pushing the next lower line select key moves the cursor to the bottom half of the transponder window. This key has a toggle function between active and standby. When active, the mode of operation is changed by rotation of one of the tune knobs.

(11) When TCAS II is installed, the modes are as follows:

- ATC ON   Replies on Modes S and A with no altitude reporting
- ATC ALT   Replies on Modes A, C, and S with altitude reporting
- TA ONLY   The TCAS traffic advisory mode is enabled
- TA/RA   The TCAS TA mode and the RA mode are both enabled.

(12) When TCAS I is installed, the modes are as follows:

- ATC ON   Replies on Modes A with no altitude reporting
- ATC ALT   Replies on Modes A and C with altitude reporting
- TA ONLY   The TCAS traffic advisory mode is enabled.

(13) When TCAS I is not installed, the modes are as follows:

- ATC ON   Replies on Modes A with no altitude reporting
- ATC ALT   Replies on Modes A and C with altitude reporting.

(14) There is a secondary function available when the cursor is in the lower transponder window. Pushing the 1/2 key in the lower RMU panel selects the active transponder. With TCAS installed, the banner line at the top of the transponder window indicates ATC/TCAS. The modes are those listed previously with TCAS installed.

(15) The remaining two line select keys move the cursor to either the RANGE line or to the vertical window line. Repeated pushing of the RANGE line select key toggles through the range selections (6, 12, 20, 40). The TUNE knob changes the range when the cursor is in the RANGE window. The vertical window displays are: NORMAL, ABOVE, BELOW, and are selected by repeated pushing of the line select key or by rotation of the TUNE knob.

(16) Circuitry within the RMU is designed to control the light intensity and colors of the RMU and supply color tracking across the brightness levels. The CRT brightness is adjusted by pushing the DIM button on the front of the panel and using the tuning knob in the same manner as other functions selected. There is also a photo sensor on the front of the RMU that senses the ambient light condition and adjusts the RMU intensity to compensate for varying levels of light as the aircraft maneuvers in the sunlight. This is a feature that keeps the readability of the RMU at a high level while not requiring the pilot to turn the intensity up and down each time the panel passes from shadow to sunlight.

(17) As a safety feature of the RMU, if any of the components of the radio system fail to respond to commands from the RMU, the frequencies or operating commands associated with that particular function are removed from the RMU and replaced with dashes. This alerts the crew that the radio system operation is not normal.

(18) Also available in the RMU is a maintenance mode of operation, when not in flight. During this mode, various pages are used giving maintenance personnel access to the maintenance log data and operating conditions of the radio system. In the aircraft maintenance mode, parameters can be examined by the crew, but not modified in any way.

(19) The paragraphs that follow describe each control on the RMU.

(a) Photo Sensor

1 The photo sensor senses the ambient light and causes the CRT brightness to be automatically adjusted to compensate for varying levels of light as the aircraft maneuvers into and out of the sunlight.

(b) Transfer (Flip-Flop) Key

1 The transfer key, when pushed, flip-flops the active frequency (top line) and the preset frequency (bottom line) of the COM or NAV window. Pushing both transfer keys simultaneously, while on the ground, gives entry into the aircraft maintenance mode. For further information about the aircraft maintenance mode, refer to Section 4, Maintenance Practices, of this manual.

(c) Line Select Key

1 The first push of the line select key moves the yellow cursor to surround the data field associated with that particular line select key. This electronically connects the data field to the tuning knobs so frequency or mode can be changed. For some functions, additional pushing of the line select key toggles the modes or recalls stored frequencies. The line select key, if pushed and held for certain functions, lets ADF and ATC memories be recalled. This key is also used to enter and exit direct tune mode for the COM and NAV.

(d) Tuning Knobs

1 The tuning knobs are used to modify the data field enclosed by the cursor. This can be frequency or mode depending upon the selected data field.

(e) Function Keys

1 SQ Key

a Pushing the SQ key causes the COM radio to open its squelch and lets any noise or signal present in the radio be heard in the audio system. The squelch key is strictly a toggle. Pushing the key toggles SQ. The letters SQ are annunciated along the top line of the COM window when the squelch is opened by using this key.

2 DIM Key

a Pushing the DIM key connects the RMU brightness control knob supplying adjustment to the display to match overall cockpit brightness.

3 1/2 (Cross-Side) Key

a With the cursor in any window, except the ATC or TCAS display, pushing the 1/2 key transfers the entire RMU operation and display to the cross-side system. The legend color changes from white to magenta when the RMU is displaying and in control of data associated with the cross-side system. If the cursor is in the ATC or TCAS display window, pushing this key selects the transponder for operation.

4 STO Key

a With the cursor placed around the temporary (TEMP) display, pushing the STO key sets the TEMP COM/NAV preselect frequency in stored memory and assigns it a numbered location. The ADF and ATC each have one memory location. With the cursor placed around that frequency or code, pushing the STO key sets the current ADF frequency or ATC code in stored memory.

5 ID Key

a Pushing the ID key initiates the transponder identification response mode. The ID squawk terminates after 18 seconds. The identification response mode can also be activated with the control yoke-mounted pushbuttons.

6 PGE Key

a Pushing the PGE key once changes the RMU display to the RMU page menu, except when operating in the aircraft maintenance mode. Pushing the PGE key a second time has no effect. When not on the main operating page, the RMU assigns a return function to the lower left line select key. Pushing this key returns to the main operating page.

7 TST Key

a With the yellow cursor positioned in a window, pushing the TST key initiates the internal self-test circuits for a complete end-to-end test of that component function. The TST key is held down for the duration of the test: about 2 seconds for COM transceiver, 5 to 7 seconds for DME, ATC, ADF, and about 20 seconds for NAV (VOR/ILS). Releasing the TST key at any time immediately returns the function to normal operation.

8 DME Key

a The DME key deslaves the DME from the active VOR frequency and lets tuning of a different DME channel without changing active VOR. Successive pushes of the DME key enable display and selection of the DME channels in VHF and tactical air navigation (TACAN) formats.

(f) Cursor

1 The yellow cursor encloses the data field selected by the line select key. The cursor in the COM or NAV window can enclose either the preset frequency or the memory mnemonics. Selection is made by cycling the preset frequency line select key. The yellow cursor homes to its last position in the COM window 20 seconds after the last tuning operation on the RMU. Home can be either the preset COM frequency or the memory mnemonics.

B. CD-850 CDH

(1) Figure 2-4-2 shows a graphical view of the CD-850 CDH. The CDH is located in the cockpit instrument panel of the aircraft. Table 2-4-2 gives leading particulars for the CD-850 CDH.

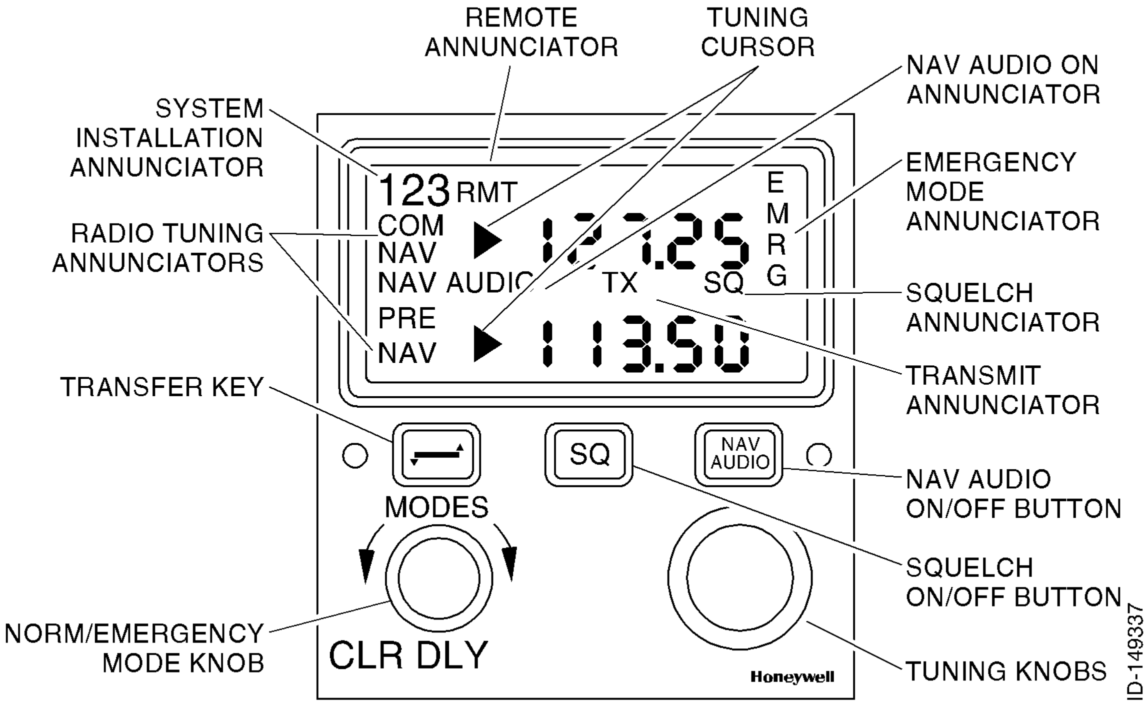

Figure 2-4-2. CD-850 CDH

Table 2-4-2. CD-850 CDH Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	2.62 in. (66.7 mm)
• Width	2.38 in. (60.3 mm)
• Length	7.54 in. (191.5 mm)
Weight	1.25 lb (0.568 kg)
Power requirements:	
• Primary	28 V dc, 4 W (max)
• Panel lighting	5 V ac or dc, 0.025 W (max)
User replaceable parts:	
• Knob, mode	HPN 800B0718
• Knob, coarse tuning	HPN 800B0714
• Knob, fine tuning	HPN 800B0715
• Setscrew, 4-40 x 3/32-in. (6)	HPN 100A4634-01
Mating connector	MS3126F20-41SW, HPN 4000809-607
Mounting	Panel mount

(2) The CD-850 CDH is an alternate or emergency backup capability for tuning the No. 1 VHF COM module and the No. 1 VHF NAV receiver module. This is done on private-line data buses that remain operational if the primary RSB tuning is not available or if the pilot/operator wishes to override the bus tuning for any reason. The CDH listens on the RSB and displays the active frequencies of these two modules.

(3) The CDH uses a transflective, dichroic (black dye) LCD to supply enhanced readability and reliability. The panel lettering and buttons are internally lit using aviation blue-white lighting.

(4) The normal and emergency modes are submodes that are selected by the mode key. The paragraphs that follow describe each control and annunciator on the CDH.

(a) System Installation Annunciator

1 This annunciates the radio system (1, 2, or 3), indicating to which system the CDH is connected. In the Cessna Citation XLS, the No. 1 annunciator is on, indicating the CDH is connected to the No. 1 COM and No. 1 NAV.

(b) Remote Tune Annunciator

1 This annunciator is inactive in the Cessna Citation XLS.

(c) Tuning Cursor

1 This annunciator is a lit triangle controlled by the transfer key. It indicates which frequency can be changed by the tuning knobs.

(d) NAV AUDIO On Annunciator

1 This annunciator indicates the NAV audio is selected on.

(e) Emergency (EMRG) Mode Annunciator

1 This annunciator indicates the CDH is placed in the emergency backup mode, which locks out all other COM and NAV tuning sources for the No. 1 COM and No. 1 NAV. The No. 1 COM and the No. 1 NAV are tuned exclusively by the CDH. This annunciator is not related to the emergency frequency of 121.5 MHz.

(f) SQ Annunciator

1 This annunciator indicates the squelch is opened by the SQ on/off switch.

(g) TX Annunciator

1 This annunciator indicates the COM transmitter is on.

(h) NAV AUDIO On/Off Button

1 This alternate action button is used to toggle NAV audio on or off.

(i) SQ On/Off Button

1 Alternate action button used to toggle COM squelch on or off.

(j) Tuning Knobs

1 The knobs change the frequency indicated by the tuning cursor. The large knob adjusts the left two numbers and the small knob adjusts the right two numbers.

(k) Normal/Emergency Mode Switch

1 This rotary switch knob gives alternate selection of the Normal and Emergency modes.

(l) Transfer Key

1 The transfer key alternately selects either the COM frequency (top) or the NAV frequency (bottom) to be connected to the tuning knobs.

(m) Radio Tuning Annunciators

1 Annunciators COM and NAV are lit individually, together with the tuning cursor, to identify the frequency at the top and bottom lines.

C. DI-851 DME Indicator

(1) Figure 2-4-3 shows a graphical view of the DI-851 DME indicator. The DME is located in the cockpit instrument panel of the aircraft. Table 2-4-3 gives leading particulars for the DI-851 DME indicator.

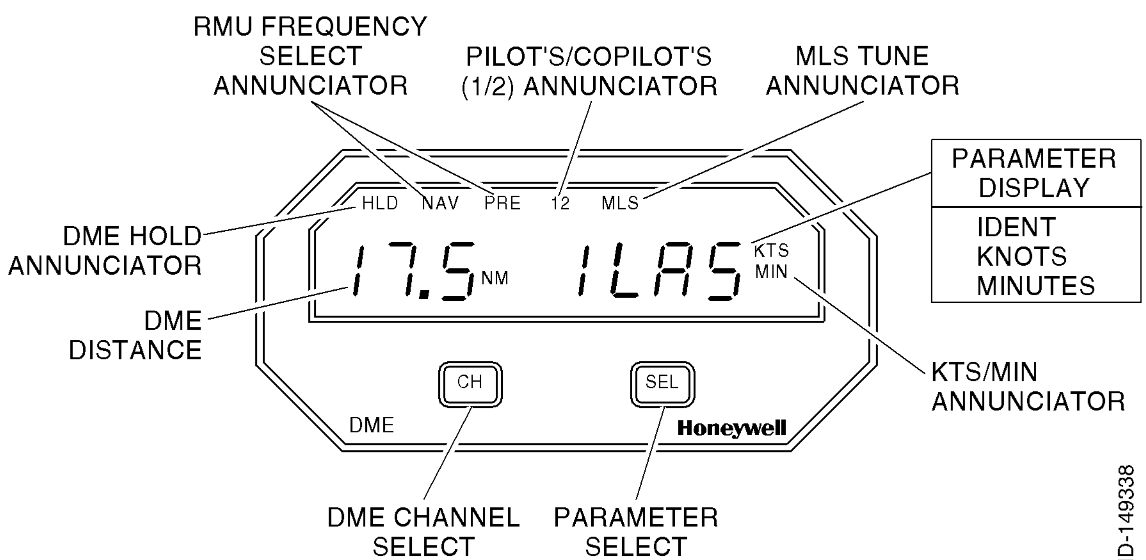

Figure 2-4-3. DI-851 DME Indicator

Table 2-4-3. DI-851 DME Indicator Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.54 in. (39.2 mm)
• Width	3.26 in. (82.8 mm)
• Length	6.27 in. (159.3 mm)
Weight	1.05 lb (0.476 kg)
Power requirements	28 V dc, 2.8 VA nominal
User replaceable parts	None
Mating connector	HPN 7500436-901
Mounting	Panel mount; clamp, HPN 7001995-1

(2) The DI-851 DME indicator displays DME-related information to the pilot. This information includes the distance to the ground station in nautical miles, the IDENT of the ground station (extracted from the Morse code identifier), the computed groundspeed of the aircraft in knots, and the TTG (time to reach the ground station) in minutes. The indicator can be used with either one or two DME receivers and is capable of displaying data for both the active and preset channels of each DME. The unit also annunciates DME hold status for each channel. All data is input to the indicator via RSB.

(3) The DME digital display is separated into two windows. The window on the left continuously displays distance in nautical miles, and the window on the right displays either the station identifier string, groundspeed in knots, or TTG in minutes.

(4) The display type is dichroic LCD, with white characters on a black background. The LCD, the legends on the two buttons, and the indicator identifier legend are backlit by electroluminescent lighting. The DME indicator display segments can be tested when CH and SEL are pushed together (all segments turn on). In the Cessna Citation XLS, the lighting intensity is controlled by the aircraft instrument dimming line.

(5) The paragraphs that follow describe each function or control on the DI-851.

(a) RMU Frequency Select Annunciator

1 NAV is displayed when the DME is associated with the active NAV channel selected on the RMU. If the preset channel is selected, the annunciator is PRE.

(b) Pilot's/Copilot's (1/2) Annunciator

1 The 1 or 2 is annunciated depending on whether the pilot's side (1) or the copilot's side (2) channel is selected as determined by the channel (CH) select button.

(c) MLS Tune Annunciator

1 MLS is displayed when a DME receiver is being tuned by the microwave landing system receiver.

(d) Parameter Display and Select (SEL)

1 The DME station identifier, the computed groundspeed of the aircraft in knots, or TTG (time to reach the ground station) in minutes is displayed as a function of the parameter SEL button. The KTS/MIN annunciator identifies which parameter is being displayed. Each time the SEL button is pushed, the display changes as shown in Table 2-4-4.

Table 2-4-4. Parameter Display and Select

SEL Button	Parameter	Annunciator
Power-up	Identifier	Blank
1st push	Groundspeed	KTS
2nd push	TTG	MIN
3rd push	Identifier	Blank

(e) DME Channel (CH) Select

1 The CH button selects which DME channel to display. At power-up, the same channel is displayed that was being displayed at power-down. If MLS is not selected, the button toggles between NAV 1, NAV 2, PRE 1, and PRE 2. Annunciators along the top of the display identify the channel being displayed.

2 The NAV and PRE refer to the frequencies selected for active and preset in the respective RMU.

(f) DME Hold Annunciator

1 HLD is annunciated if the DME frequency is split from the VOR.

D. AV-850A Audio Panel

(1) Figure 2-4-4 shows a graphical view of the AV-850A audio panel. The audio panel is located in the cockpit instrument panel of the aircraft. Table 2-4-5 gives leading particulars for the AV-850A audio panel.

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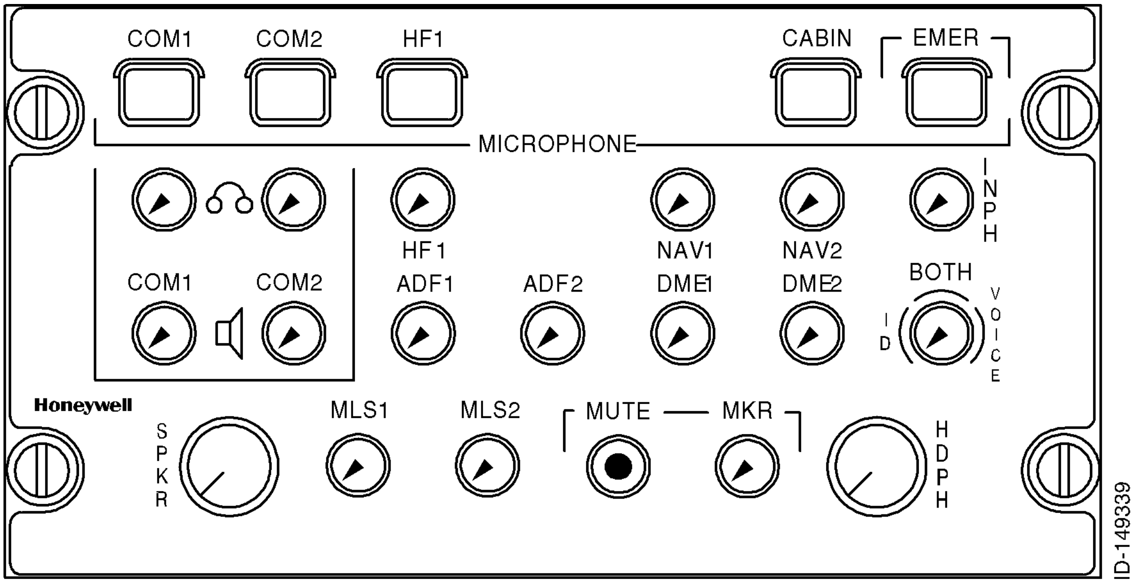

Figure 2-4-4. AV-850A Audio Panel

Table 2-4-5. AV-850A Audio Panel Leading Particulars

Item	Specification
Dimensions (maximum):	
• Length	7.10 in. (180.3 mm)
• Width	5.75 in. (146.1 mm)
• Height	3.00 in. (76.2 mm)
Weight	3.22 lb (1.50 kg)
Power requirements	28 V dc, 28 W (max)
User replaceable parts:	
• Knob speaker or headphone	HPN 7511039
• Setscrew, 2-56 x 7/8 in., cup point steel	HPN 2500148-64
Mating connectors:	
• J1	MS27473E20-A41S, HPN 2500981-195
• J2	MS27473E20-A41SB, HPN 2500981-197
Mounting	Standard Dzus rail

(2) The AV-850A audio panel receives digitized audio from remote radio units through two high speed digital audio buses. The audio panel decodes the digital data, controls the gain (volume) of the various channels, adds the channels together, does various filter functions on the audio, and outputs the audio to a digital-to-analog converter. It contains hardware for switching microphones to various radios, and hardware for the interphones as well as the cabin audio and intercoms. Amplifiers are also provided for driving headphones and speakers.

(3) The audio panels are mounted on the aircraft instrument panel, outboard of the EDS displays.

(4) The paragraphs that follow describe the audio panel switch and control functions.

(a) COM1, COM2, and HF Microphone Switches

1 Pushing these switches automatically selects the desired microphone and at the same time enables the receiver audio associated with that microphone. This happens regardless of the setting of the COM or HF audio on/off controls located under the switch.

(b) CABIN Microphone Switch

1 Pushing this switch lets the crew member make passenger address announcements through one of the loudspeakers mounted in the passenger cabin. This switch also controls a discrete which in turn controls a relay that disconnects and overrides the cabin audio entertainment system.

(c) EMER Switch

1 When the EMER switch is pushed, the microphone is connected directly to VHF COM transceiver No. 2, and the transceivers received audio is connected directly to the aircraft's headphone. The No. 2 VOR/ILS audio is also connected directly to the aircraft's headphone if it has been selected by the NAV AUDIO button on the CDH. When EMER is selected, headphone volume is controlled by the master headphone volume control. This mode also disables all other audio panel modes.

(d) INPH Volume Control

1 The interphone volume control adjusts the headset audio level when the interphone function is used. Normally, interphone audio is available only over the headset. The interphone function ties together the cross-side audio panel and any externally located maintenance audio jacks.

(e) Audio Source Control

1 Each control (COM, HF, NAV, ADF, DME) combines the function of switch and volume control.

2 Each source control (i.e., COM) energizes a particular channel's audio when unlatched (out position) and de-energizes the audio when latched (in position). Rotation of this control adjusts the audio level from minimum at the fully CCW position, to maximum at the fully CW position.

(f) ID/VOICE Control

1 The ID/VOICE control is used to filter the VOR and ADF audio signals. In the ID position, the VOR or ADF audio is filtered to enhance the Morse code identification. In the VOICE position, the audio is filtered to reduce the Morse code signal for received VOR/ILS audio. ADF audio passes through without change when VOICE mode is selected. In the BOTH position, Morse code and voice may be heard simultaneously (no filtering).

(g) Speaker and Headphone Controls

1 These controls are used to adjust the overall speaker and headphone volume. They work in series with the individual audio source controls.

(h) MKR Beacon Volume Control

1 The marker volume control is a latched switch that controls the marker audio volume. It differs from the other volume controls in that it may not be turned down below a level that is adjusted by a potentiometer inside the audio panel. This prevents the marker audio from being turned down too low to be heard, causing the marker signal to be missed.

(i) Marker Beacon MUTE Control

1 Pushing the control activates the marker mute function that is used to temporarily silence the marker beacon audio (nonlatching). When the marker audio is muted, it remains muted as long as the audio level is above a threshold setting. When the audio level drops below the threshold, a time-out sequence begins that continues to mute the marker audio for a fixed period of time. After the time-out, the marker audio is unmuted.

E. RCZ-851E Integrated COM Unit

(1) Figure 2-4-5 shows a graphical view of the RCZ-851E integrated COM unit. The COM units are located in the avionics nose bay or tailcone of the aircraft. Table 2-4-6 gives leading particulars for the RCZ-851E COM unit.

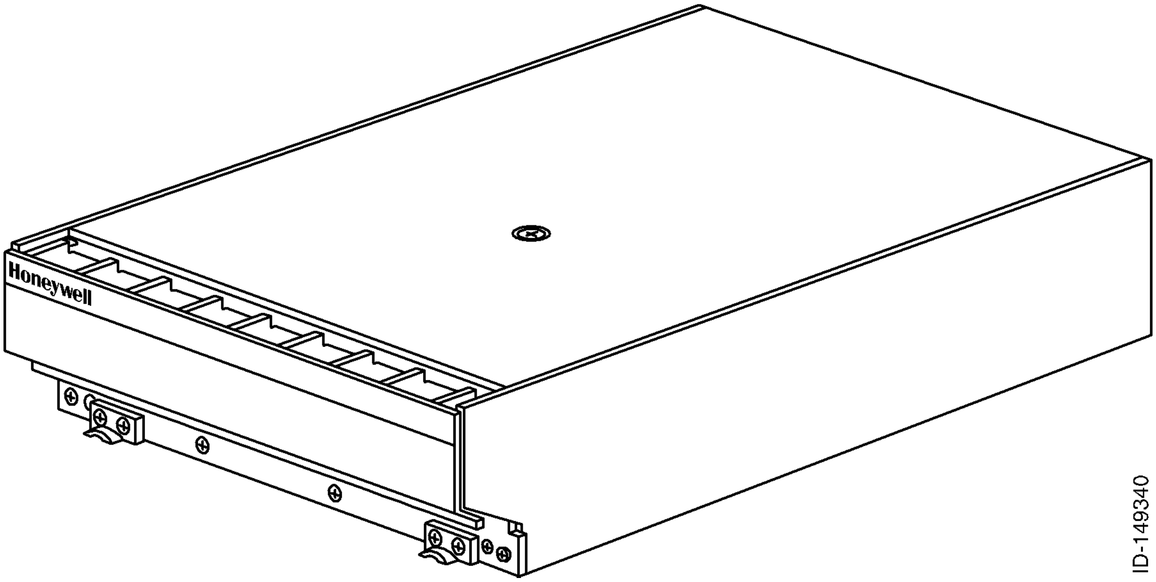

Figure 2-4-5. RCZ-851E Integrated COM Unit

Table 2-4-6. RCZ-851E Integrated COM Unit Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	3.38 in. (85.9 mm)
• Width	8.90 in. (226.1 mm)
• Length	14.1 in. (355.9 mm)
Weight:	
• RCZ-851E	11 lb (4.99 kg)
Power requirements:	
• RCZ-851E	28 V dc, 240 W (max) (transmit) 28 V dc, 48 W (max) (receive)
User replaceable parts:	
• XC-850 cluster module (RCZ-851E)	HPN 7510784-904
• TR-850 COM module (RCZ-851E)	HPN 7510764-902
• XS-852A diversity transponder module (RCZ-851E)	HPN 7517400-902
Mating connector	HPN 7500294-106
Mounting:	
• Tray	MT-851 tray, HPN 7510124-920
• Fan	HPN 7500524-002

Table 2-4-6. RCZ-851E Integrated COM Unit Leading Particulars (cont)

Item	Specification
Strap option board mounting:	
• Strap board assembly	HPN 7510280-901
• Strap chassis	HPN 7510346-901
• Strap chassis cover	HPN 7510349
NOTE: One strap chassis holds two strap option boards. This can be any combination, depending on installation.	

(2) The RCZ-851E integrated COM unit is a complete, self-contained communication system. It contains the VHF COM transceiver and the ATC transponder. Also within the COM unit is a cluster module that has the circuitry necessary to handle all the digital outputs of the communications modules and place them on the digital audio and radio system buses. Each one of the modules is self-contained within its own housing, has its own internal power supply, and connects to the cluster module via ribbon cable. Cooling is supplied by a noncritical, rack-mounted fan. Temperature sensors inside the individual modules report temperature rise to the cluster module, which switches the fan on and monitors its operation. When the temperature drops sufficiently, the fan is switched off.

(3) In the RCZ-851E COM unit, the cluster module is a single printed circuit board that is attached to the rear connector nearest to the outside of the rack (J1). The transponder is the diversity Mode S.

(4) A heat sink is associated with the COM unit and is attached to the front of each of the modules to supply a heat path from the internal structure of the box to the front surface, where there is adequate radiating surface in the free area. At the rear of the COM unit are flush-mounted antenna connectors and the aircraft harness connector.

(5) The cluster module has its own on-board power supply and receives its primary 28-volt input power from both the VHF COM transceiver module and the transponder module so that if either of them is energized, the cluster module is energized. The COM cluster module contains audio interface circuitry for the signals from the COM unit. Because of the nature of its operation, the transponder has no audio output circuitry.

F. RNZ-850/RNZ-850B Integrated NAV Unit

(1) Figure 2-4-6 shows a graphical view of the RNZ-850/850B integrated NAV unit. The NAV units are located in the avionics nose bay of the aircraft, or in some installations the pilot's RNZ-850 NAV unit is located in the tailcone. Table 2-4-7 gives leading particulars for the RNZ-850/850B integrated NAV unit.

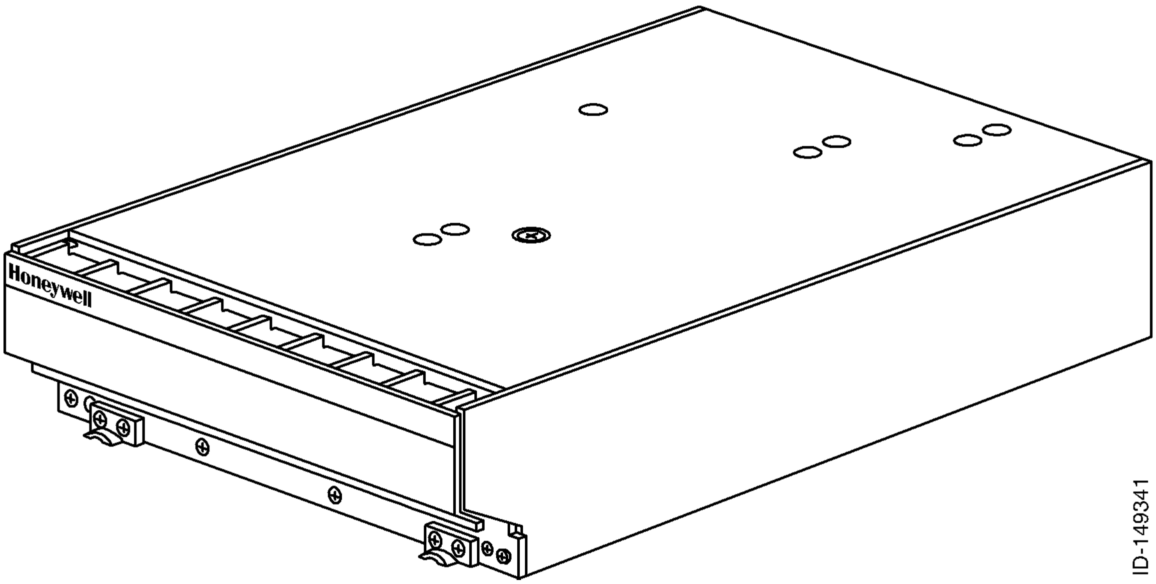

Figure 2-4-6. RNZ-850/850B Integrated NAV Unit

Table 2-4-7. RNZ-850/850B Integrated NAV Unit Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	3.38 in. (85.9 mm)
• Width	8.90 in. (226.1 mm)
• Length	14.01 in. (355.9 mm)
Weight:	
• RNZ-850	13.6 lb (6.17 kg)
• RNZ-850B	11.9 lb (5.45 kg)
Power requirements:	
• RNZ-850	28 V dc, 69 W (max)
• RNZ-850B	28 V dc, 55 W (max)
User replaceable parts:	
• XN-850 cluster module (RNZ-850/850B)	HPN 7510164-921
• NV-850 NAV module (RNZ-850/850B)	HPN 7510134-831
• DM-850 DME module (RNZ-850/850B)	HPN 7510184-902
• AD-850 ADF module (RNZ-850)	HPN 7510114-811
Mating connector	HPN 7500359-911
Mounting:	
• Tray	MT-851 tray, HPN 7510124-910
• Fan	HPN 7510295-901

Table 2-4-7. RNZ-850/850B Integrated NAV Unit Leading Particulars (cont)

Item	Specification
Strap option board mounting:	
• Strap board assembly	HPN 7510280-901
• Strap chassis	HPN 7510346-901
• Strap chassis cover	HPN 7510349
NOTE: One strap chassis holds two strap option boards. This can be any combination, depending on installation.	

(2) The RNZ-850/850B integrated NAV unit is a complete, self-contained navigation system. It contains the NV-850 VHF NAV receiver, the DM-850 DME, and the DF-850 ADF modules (850 only). Also within the RNZ-850/850B is an XN-850 cluster module that supplies the interface with the NV-850, DM-850, DF-850, and other units of the integrated radio system, and digitizes the received audio for the digital audio system. Cooling is supplied by a noncritical, rack-mounted fan. Temperature sensors inside the individual modules report temperature rise to the cluster module, which switches the fan on and monitors its operation. When the temperature drops sufficiently, the fan is switched off.

(3) A heat sink is associated with the NAV unit and is attached to the front of each of the modules to supply a heat path from the internal structure of the box to the front surface, where there is adequate radiating surface in the free area. At the rear of the navigation unit are flush-mounted antenna connectors and the aircraft harness connector.

(4) The cluster module has its own onboard power supply and receives its primary 28-volt input power from either the VHF NAV receiver module, the DME module, or the ADF module so that if any of them is energized, the cluster module is energized. The NAV cluster module contains audio interface circuitry for the signals from the VHF NAV and ADF modules. The Morse decoder within the DME module sends one data bit during Morse tones. The cluster module includes this data bit in the digital audio data and the tone is recreated by the audio panel.

G. AT-860 ADF Combined Sense/Loop Antenna

(1) Figure 2-4-7 shows a graphical view of the AT-860 ADF antenna. The ADF antenna is located on the exterior of the aircraft. Table 2-4-8 gives leading particulars for the AT-860 ADF antenna.

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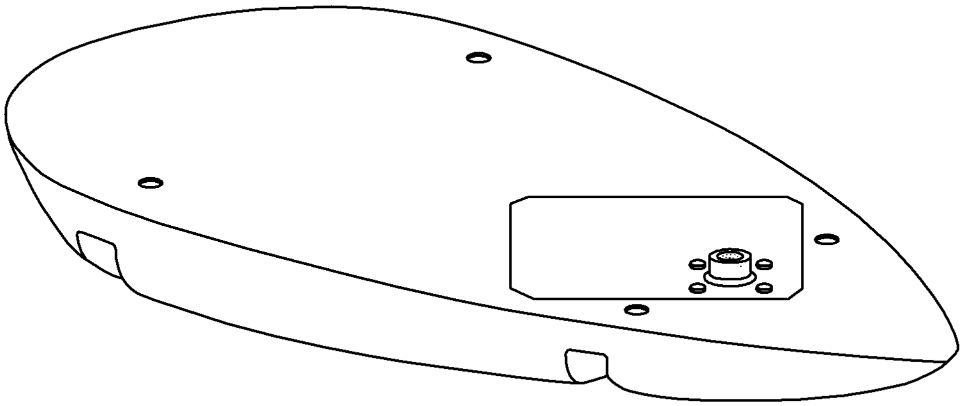


Figure 2-4-7. AT-860 ADF Antenna

Table 2-4-8. AT-860 ADF Antenna Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.51 in. (38.4 mm)
• Width	8.33 in. (211.6 mm)
• Length	16.30 in. (414.0 mm)
Weight	3.7 lb (1.68 kg)
Power requirements	+15 V dc supplied by RNZ-850, 1.9 W
User replaceable parts	None
Mating connector	Cannon KPT08P12-10S, HPN 7500489-524
Mounting	Exterior of fuselage
Gasket	HPN 7020801-932

(2) The AT-860 ADF antenna performs the functions of reception, amplification, and combination of RF signals to yield low-frequency reception and directional information. The antenna also has a self-test circuit that radiates a 120-kHz signal into the sense and loop antennas. This checks the operation of both the AT-860 ADF antenna and the DF-850 ADF receiver module. Proper operation is indicated by a 1-kHz tone and a bearing indication of 135 degrees relative to the nose of the aircraft.

3. Operation

A. Introduction

(1) Figure 2-4-8 shows the integrated RSBs. Command, control, and data communications between LRUs is through the RSB. The radio communication bus (RCB) within the COM and NAV units is on a ribbon cable. Digital audio from the NAV and COM units to the audio panels is via digital audio buses. Command and control data from the CDH is delivered to COM No. 1 and NAV No. 1 on private-line data buses.

(2) Each remote radio unit contains a number of functional modules. These are packaged as follows:

- RCZ-851E integrated COM unit
- TR-850 VHF COM transceiver module
- XS-852A diversity Mode S transponder module
- XC-850 COM cluster module (RSB and digitized audio interface)
- RNZ-850 integrated NAV unit
- NV-850 VHF NAV receiver module
- DM-850 DME transceiver module
- DF-850 ADF receiver module
- XN-850 NAV cluster module (RSB and digitized audio interface)
- RNZ-850B integrated NAV unit
- NV-850 VHF NAV receiver module
- DM-850 DME transceiver module
- XN-850 NAV cluster module (RSB and digitized audio interface).

(3) Controls and the associated displays for the radios are available in the units that follow:

- AV-850A audio panel
- RM-850 RMU
- CD-850 CDH.

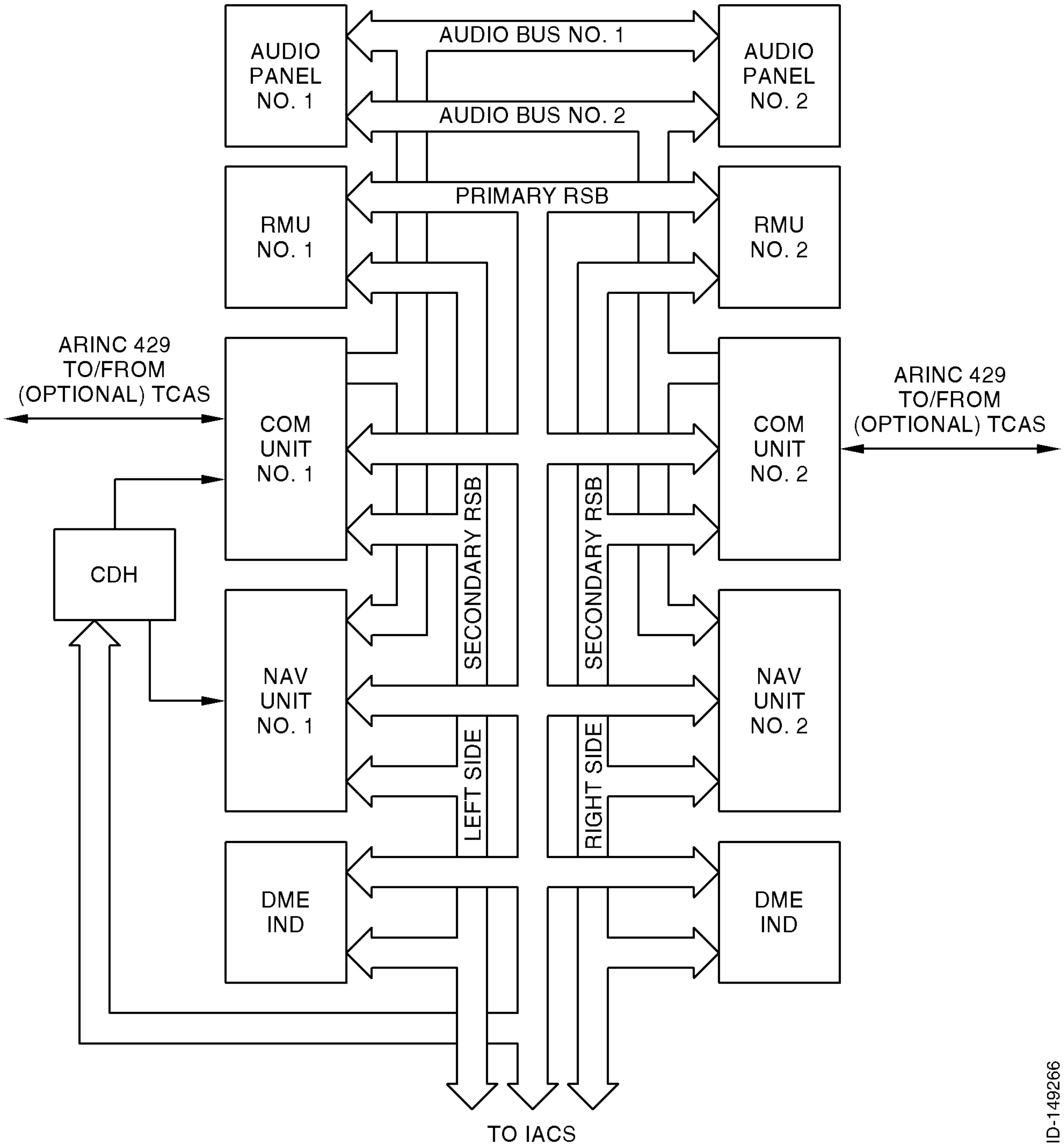


Figure 2-4-8. Radio System Data Buses

(4) The basic radio control functions are as follows:

- VHF COM mode and frequency
- VHF NAV mode and frequency
- ADF mode and frequency
- Transponder reply code and mode
- TCAS mode, range, and vertical window
- DME (independent channeling in the hold mode)
- Audio panel.

(5) Frequency and mode control of the radios can be input by the operator from the RMU, the FMS, or the CDH. The CDH is somewhat limited since it is only connected to COM No. 1 and NAV No. 1. Microphone selection, radio headset and speaker selection, and volume control are supplied by the audio panel. Audio switching control is input by controls on the audio panel. The received audio signals are transmitted from the remote units to the audio panel via a dedicated digital audio bus. The microphone audio output from the audio panel to the remote-mounted transmitters is analog.

(6) Basic to the overall system design are cluster modules in the COM and NAV remote units. The cluster module is an interfacing element that collects data from the RSB, distributes this data to the respective functional modules (ADF, DME, etc.) via RCB, and also collects data via RCB from the functional modules to be broadcast on the RSB. The cluster module is also responsible for digitizing the received audio and transmitting the digitized data on the digital audio bus.

B. RM-850 RMU Interface

(1) Refer to Figure 2-4-9 for the RM-850 RMU interface diagram.

(2) The RMUs broadcast messages addressed to radio functional modules and receive data from the radios via the RSB. Three major functions of the RMU are to output tuning (channel or frequency) control data, output operational mode control data for the radios, and display the tuned active channel or frequency and operational mode.

(3) ATC identification input is at ground when a crew member pushes either of the yoke-mounted remote ident buttons. The ground is applied to both RMUs, which send the appropriate data command out on the RSB.

(4) Other inputs include power, lighting, and ground connections.

(5) Weight on wheels is at ground when the aircraft is on the ground (WOW is true).

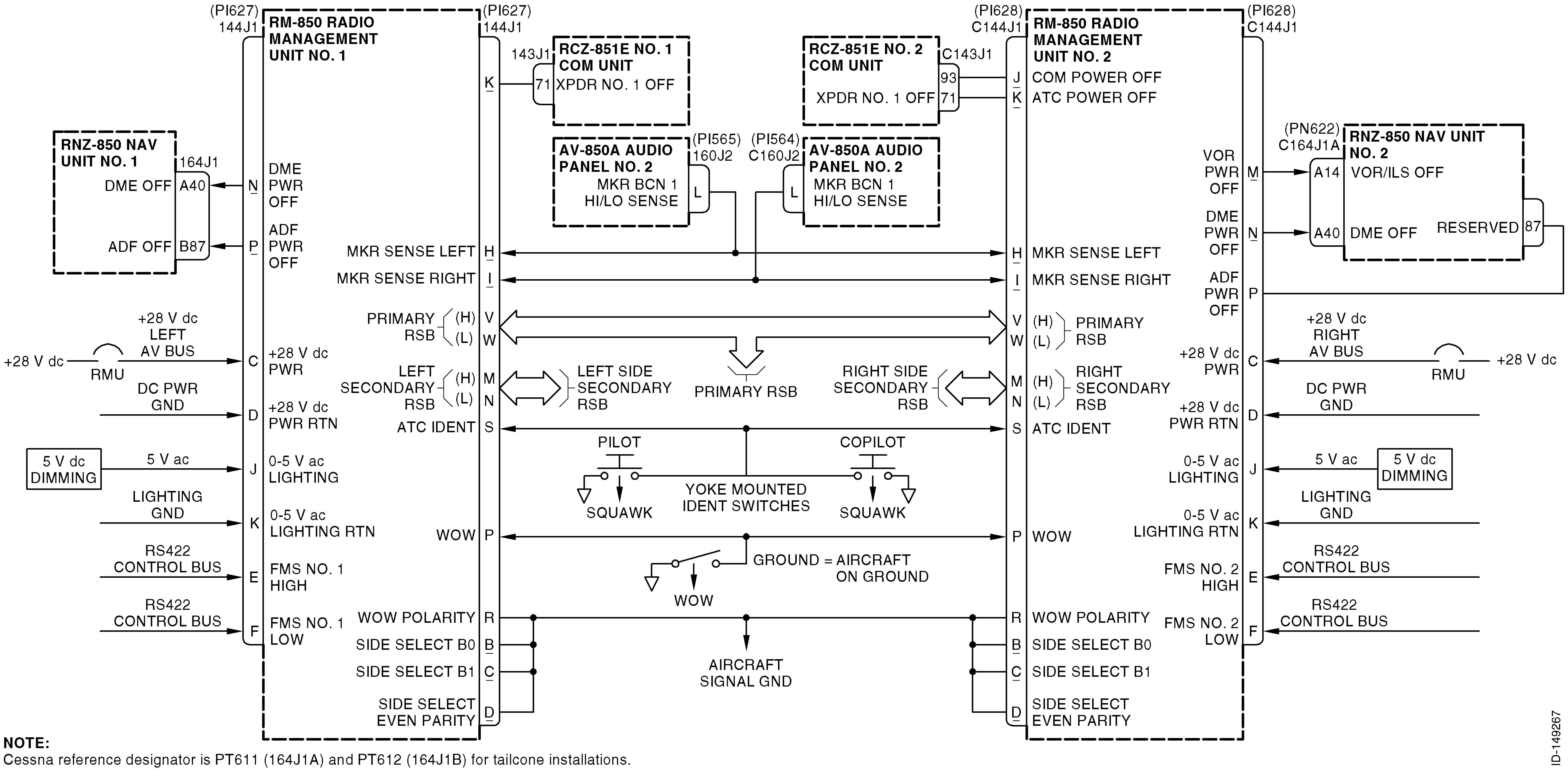
(6) On the ground, the RMU initiates a system power-on self-test (POST) when power is first applied to the radio system and at other times with WOW when power has been off for more than 10 seconds.

(7) The first page to appear on the RMU screen is POST in progress. POST lasts 45 seconds. During POST, the following is observed on the HSI display on both PFDs:

- Marker indicators and tones annunciate in the order of 3000 Hz (white inner marker), 1300 Hz (amber middle marker), and 400 Hz (blue outer marker).
- Localizer and glideslope deviation bars indicate centered course for approximately 2 seconds with flags out of view.
- Localizer and glideslope deviation bars deflect left (localizer) and up (glideslope) one dot deflection, for approximately 2 seconds with flags out of view.
- If the course selector is on zero degrees, the VOR deviation bar centers on a course of zero degrees. TO and RMI indicates zero degrees north for approximately 5 seconds with flags out of view.
- DME TEST appears.
- 10.0 NM, 120 knots, and 5 minutes TTG appear.
- RMI ADF pointer slews to 135 ± 10 degrees, relative to aircraft heading.
- Audio tone is heard through the audio system.

(8) The system also includes a pilot-activated self-test (PAST) that is initiated by pushing a line select key to put the cursor in the window for the module to be tested, and pushing and holding the TST button. Details of the PAST are found in the Cessna Citation XLS AMM and fault isolation manual (FIM). For full maintenance information on the radio system, refer to the PRIMUS II Integrated Radio System Operation and Installation Manual, Honeywell Pub. No. A15-3800-001.

(9) For full operational information on the RMU, CDH, DME indicator, and audio panels, refer to PRIMUS II Integrated Radio System Pilot's Manual, Honeywell Pub. No. A28-1146-050.



NOTE:
Cessna reference designator is PT611 (164J1A) and PT612 (164J1B) for tailcone installations.

Figure 2-4-9. RMU Interface Diagram

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C. CD‑850 CDH Interface

(1) Refer to Figure 2‑4‑10 for the CD‑850 CDH interface diagram.

(2) The NAV ACH SHIFT LOAD and NAV ACH CLOCK inputs come from the NAV module and are used to control when the NAV ACH DATA is sent to the NAV module. The COM ACH DATA is sent to the COM module on a recurring cycle. The difference in timing is because of differences in module software operations.

(3) The WOW input allows the POST to take place only if the aircraft is on the ground when the CDH is turned on.

(4) The RSB input is used to display the active frequencies of the COM No. 1 and NAV No. 1 modules. If there is an inflight power failure, the CDH comes back online displaying the same frequencies that were active prior to the failure.

(5) Other inputs include power, lighting, and ground connections.

D. DI‑851 DME Indicator Interface

(1) Refer to Figure 2‑4‑11 for the DI‑851 DME indicator interface diagram.

(2) All data is input to the indicators via the RSB. The indicators are receive‑only devices; there are no outputs. The data is used to display DME‑related information.

(3) Other inputs include power, lighting, and ground connections.

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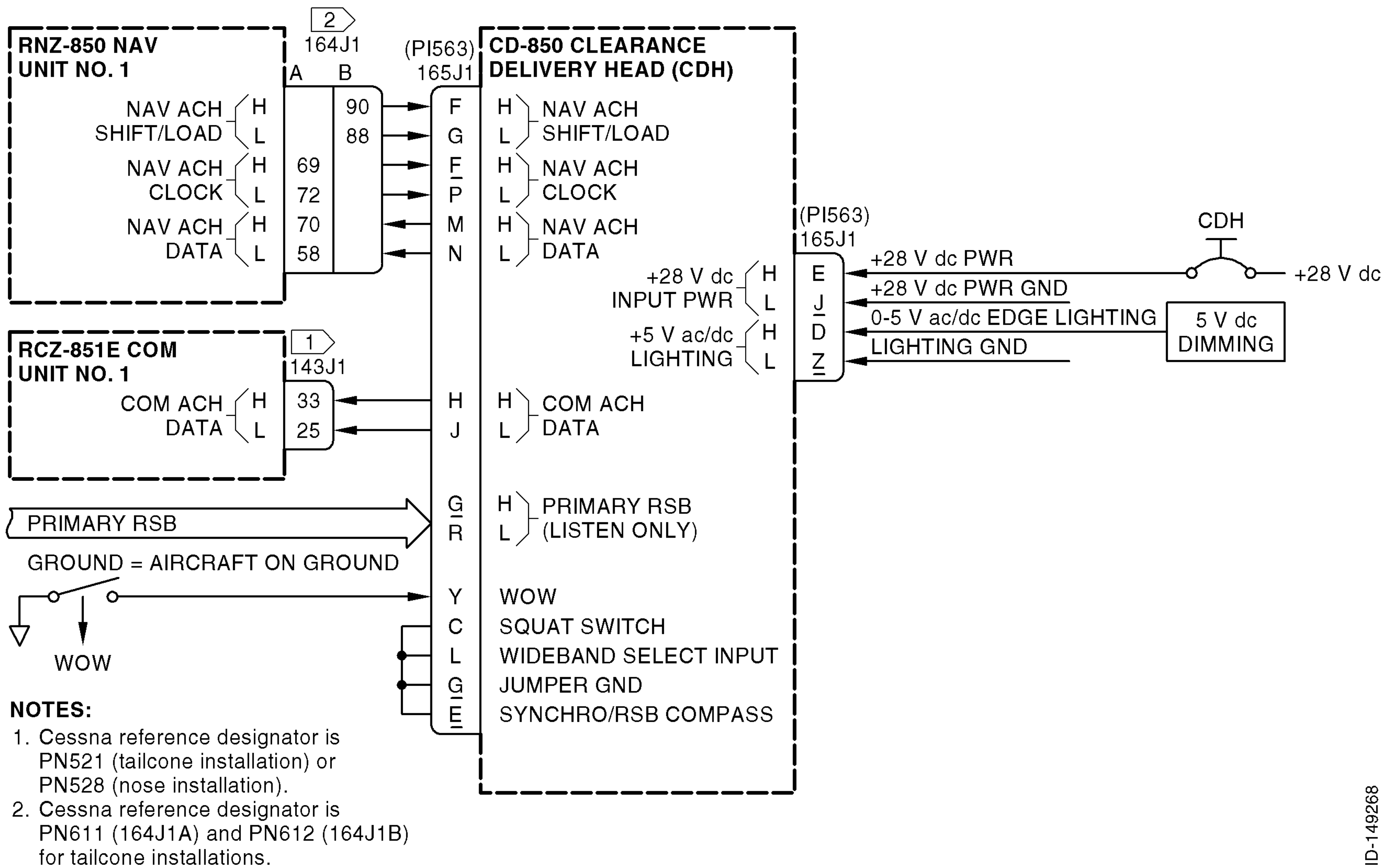


NOTES:
1. Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).
2. Cessna reference designator is PN611 (164J1A) and PN612 (164J1B) for tailcone installations.

Figure 2-4-10. CD-850 CDH Interface Diagram

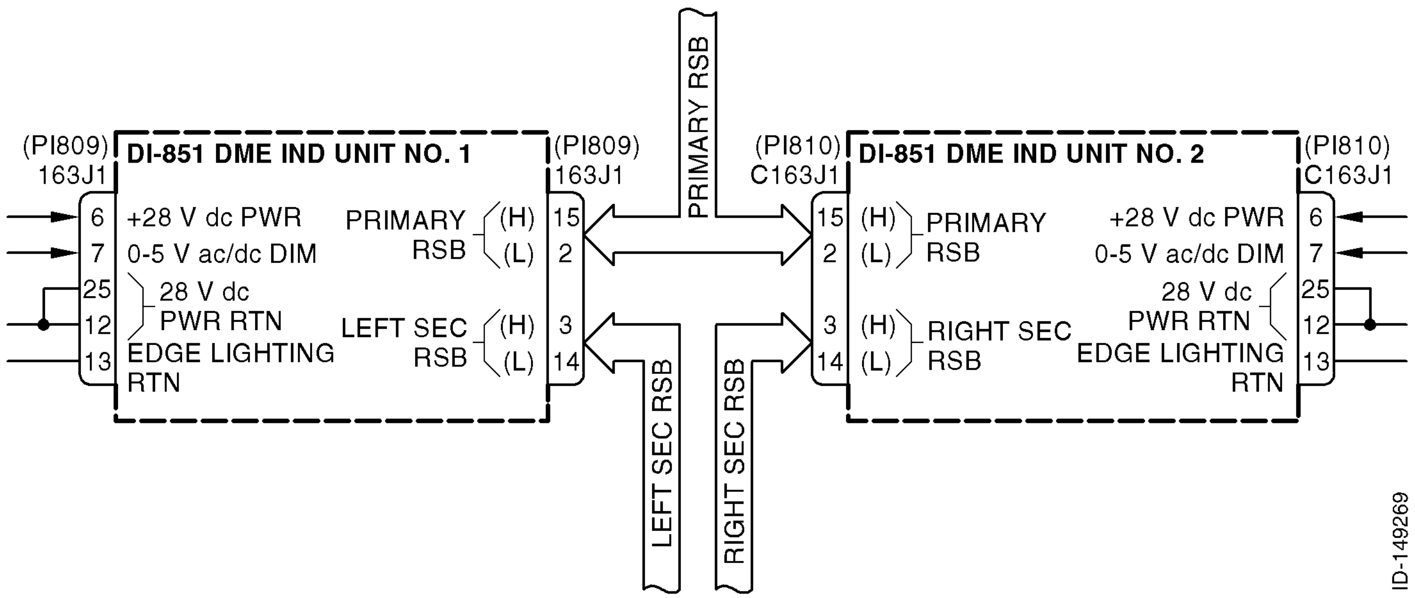


Figure 2-4-11. DME Indicator Interface Diagram

E. AV-850A Audio Panel Interface

(1) Refer to Figure 2-4-12 for the AV-850A audio panel interface diagram.

(2) The AV-850A audio panel receives digitized audio from the remote units via two high-speed digital audio buses. Each audio control unit selects the appropriate channels from this digital audio bus and reconstitutes headphone and speaker signals. This allows the system to individually select the radio function each crew member desires to hear. There is a row of microphone selector buttons along the top edge that select the desired transmitter/receiver. At the same time, it automatically enables the receive audio associated with that transmitter/receiver, regardless of the condition on the audio ON/OFF buttons. The audio ON/OFF buttons are located on the lower rows of the audio control unit. Pushing the button causes it to latch stowed and the audio associated with that button turns off. Pushing the button again lets it pop out and energize the audio into the speaker and headphone, and lets the audio level be adjusted by rotating the button. Also included are master volume controls for both speaker and headphone.

(3) The audio panel has numerous connections for intercom, crew annunciation, crew communication, hot microphone, cabin address, etc., and full-time emergency warning inputs from aircraft systems. Cross-cockpit audio is supplied so that the pilot and copilot remain coordinated with each other in their selection and use of the radio system components.

(4) Digital audio offers the advantage of complete independence from grounding problems within the aircraft and the absolute elimination of ground noise pickup, whine, and cross-talk. Having the audio digitized also offers the advantage that when recovering the analog information from the digital, each volume control can be independently set by each crew member. For instance, the pilot may wish to have COM No. 1 very loud and COM No. 2 very soft in his headset while the copilot desires the VOR to be loud, COM No. 1 to be soft, and COM No. 2 to be moderate. This is easily set at the audio control units by adjusting to the desired volumes. By having the audio system digitized, various filtering and priority functions can be easily accomplished to enhance the operation and the human interfaces.

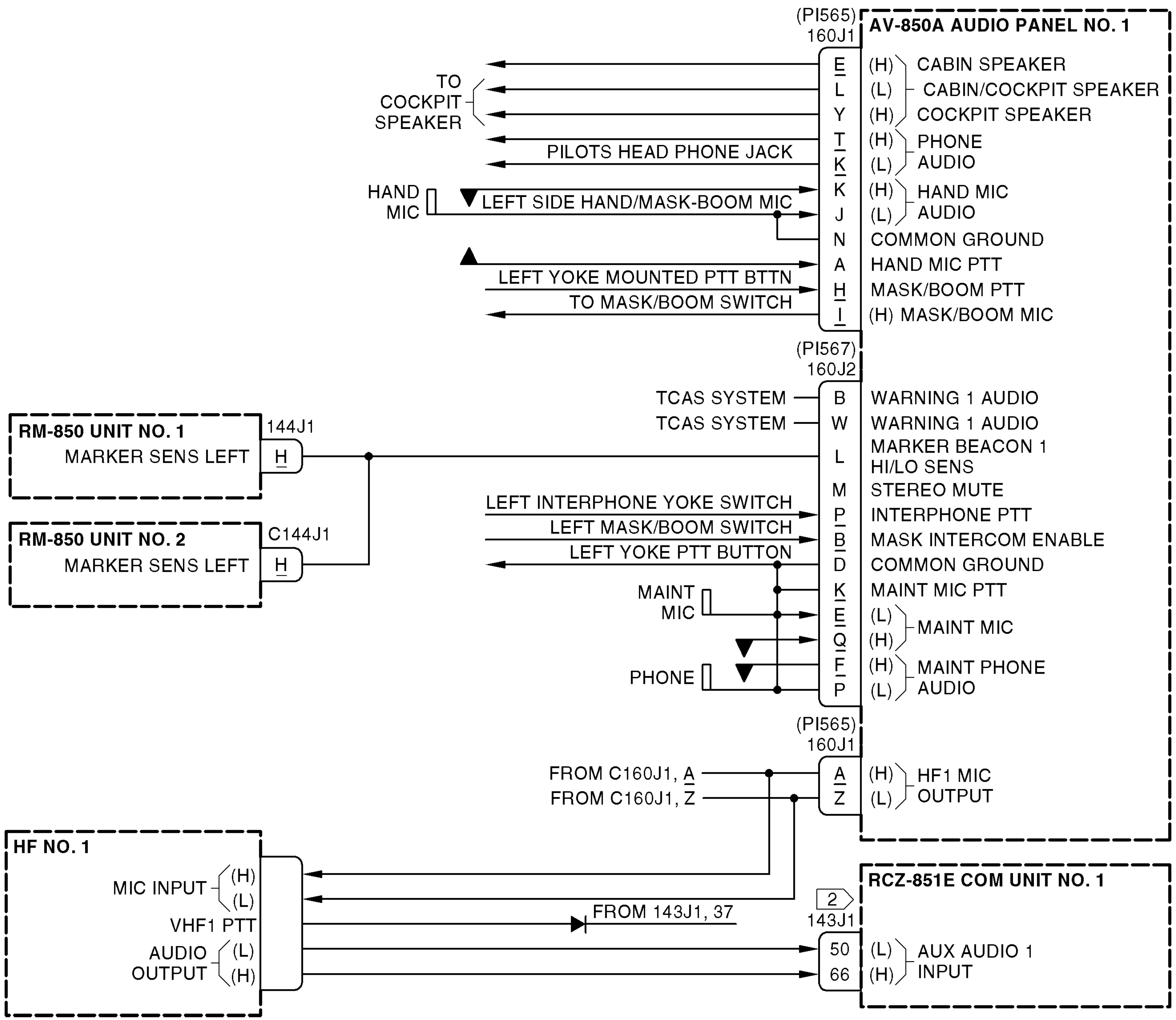
(5) The audio panel has provisions for a combination of emergency operations. In the case of power-down or failure of the audio system, there is one location (in the upper right-hand corner of the audio panel) where pushing the microphone select (labeled EMER) for the emergency COM bypasses all the circuitry within the audio panel and places the emergency COM and NAV audio into the headphone circuitry. Emergency audio is analog audio from the COM and NAV modules that are connected to the CD-850 CDH. This function is also convenient during ground operation when minimum power usage is desired.

(6) Refer to Figure 2-4-12 (Sheets 1 and 2) for the following:

- Microphone and push-to-talk (PTT) inputs and outputs
- Interphone audio and PTT
- Emergency analog audio inputs from COM No. 1 and NAV No. 1
- Speaker outputs
- Cabin address system interconnections.

(7) Refer to Figure 2-4-12 (Sheet 3) for the following:

- Digital audio bus
- Other inputs include power, lighting, and ground connections.



NOTES:

1. 2.2 kΩ 1/4 watt resistor is used to reduce emergency audio level, this is a typical value. Any value between zero and 10 kΩ may be used or a 10 kΩ pot may be installed.
2. Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).

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Figure 2-4-12 (Sheet 1). AV-850A Audio Panel Interface Diagram

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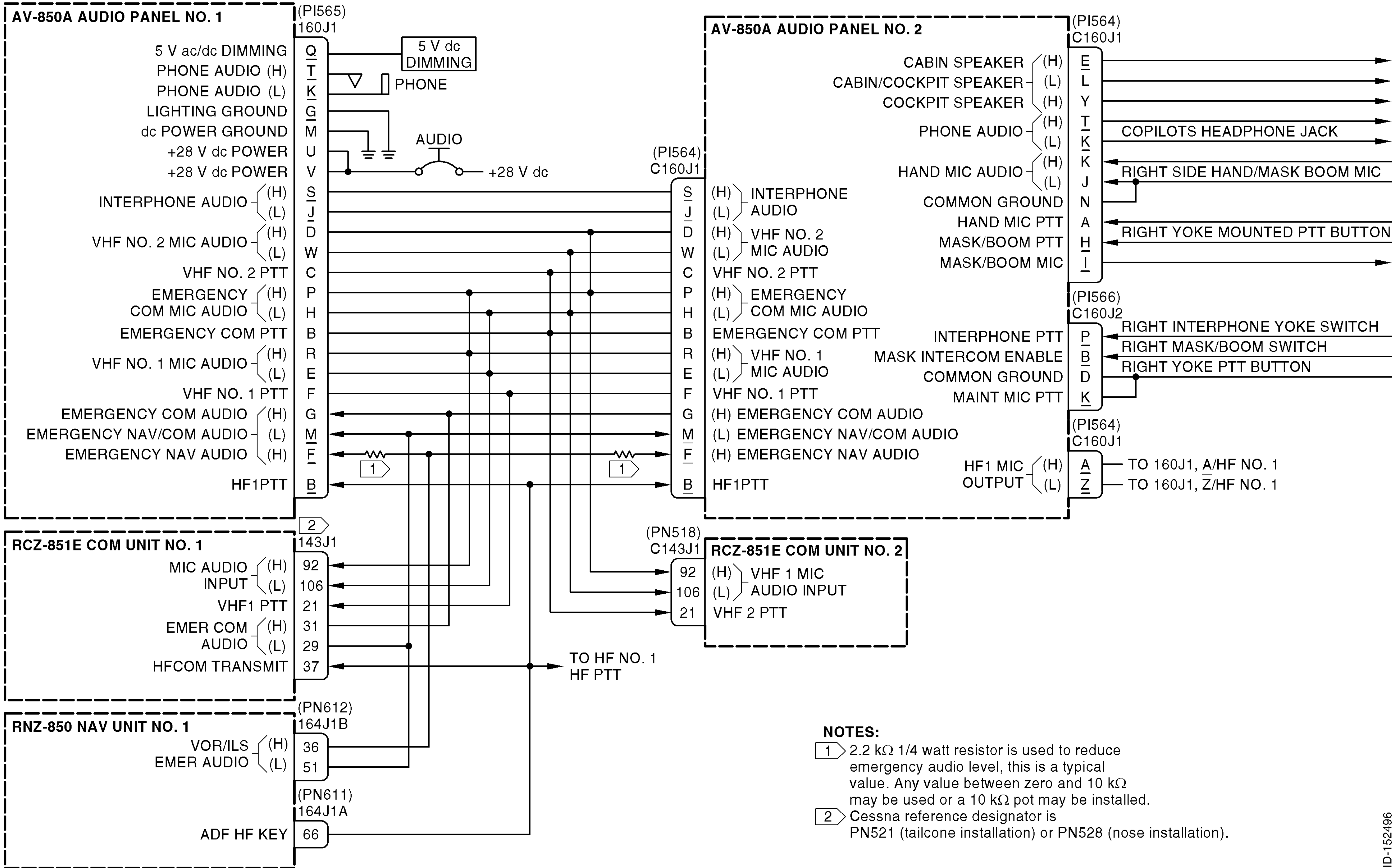
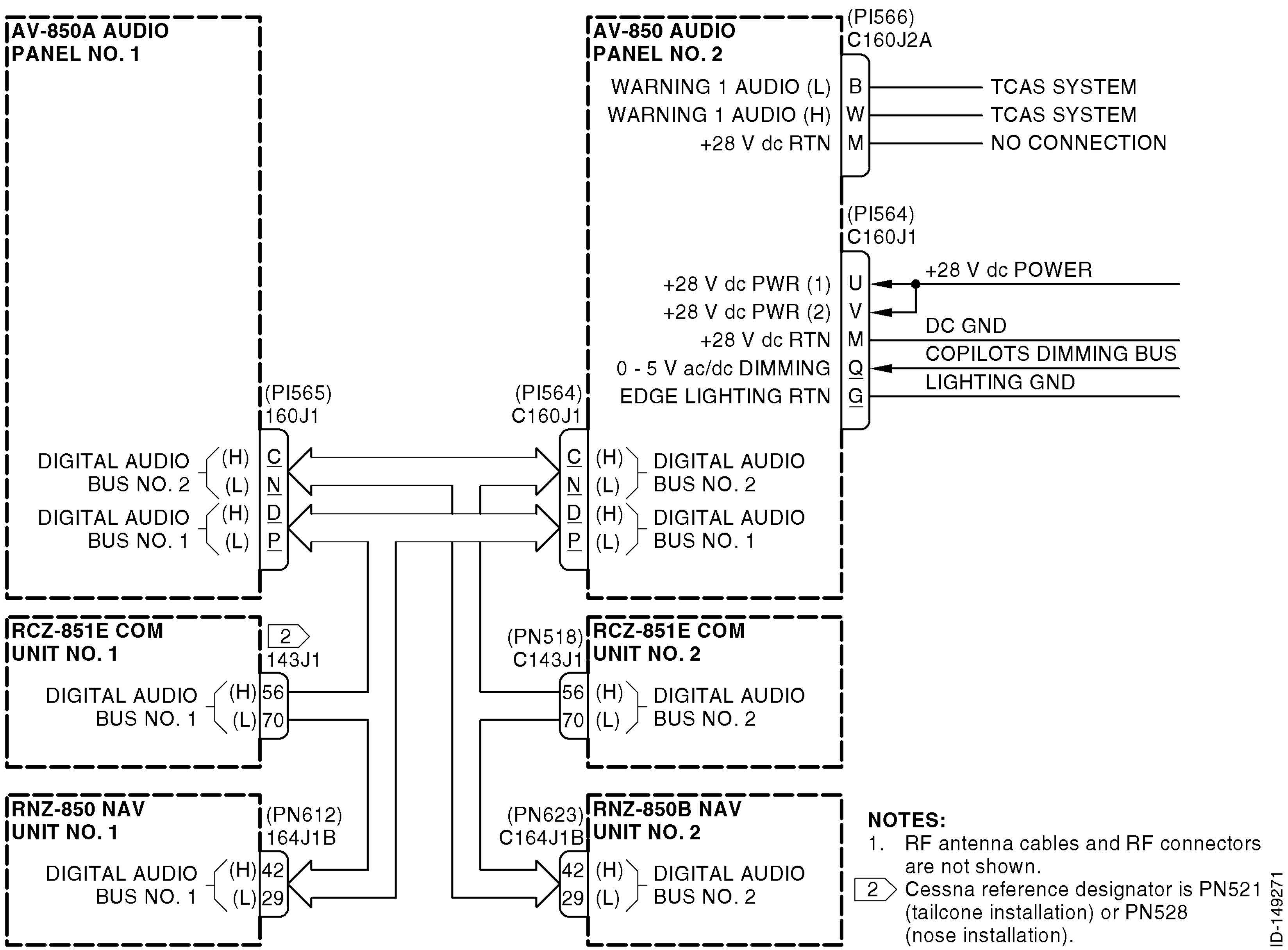


NOTES:

1. 2.2 kΩ 1/4 watt resistor is used to reduce emergency audio level, this is a typical value. Any value between zero and 10 kΩ may be used or a 10 kΩ pot may be installed.
2. Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).

Figure 2-4-12 (Sheet 2). AV-850A Audio Panel Interface Diagram



NOTES:
1. RF antenna cables and RF connectors are not shown.
2 Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).

Figure 2-4-12 (Sheet 3). AV-850A Audio Panel Interface Diagram

F. RCZ-851E Integrated COM Unit Interface

(1) Refer to Figure 2-4-13 for the RCZ-851E integrated COM unit interface diagram.

(2) The common unit connections shown include power, ground, and RSB, all of which have been covered in previous sections.

(3) Command data for the optional TCAS computer unit originates at the RMU and is transmitted via the RSB. The cluster modules in each RCZ-851E COM unit receive the data and pass it to the RMU selected active transponder, which sends the data to the TCAS computer unit via ARINC 429. The TCAS reply coordination data is handled in the reverse.

(4) During a cold start power-up, the cluster board sends word load and clock to the strap option board and receives data back. This data is sent to the modules via the RCB.

(5) The rack-mounted fan is controlled by the cluster module and is turned on when any module reports a temperature above the threshold. The threshold is different in each module. When the temperature drops below the threshold, the cluster module turns the fan off. The fan is not required for system operation.

(6) Encoded altitude data is transmitted by each MADC via ARINC 429 to both transponders.

(7) The SIMULCOM line goes to ground when either VHF COM transceiver is transmitting. This connection allows communication on different frequencies simultaneously with minimum interference. SIMULCOM desensitizes the radio that is in the RX mode while the other radio is transmitting.

(8) The WOW is used by the transponder to disable Mode S replies when the aircraft is on the ground.

(9) The mutual suppression bus goes to ground when any of the transmitters on the line is transmitting. This prevents the DME, TCAS, and transponders from interfering with each other during otherwise normal operation.

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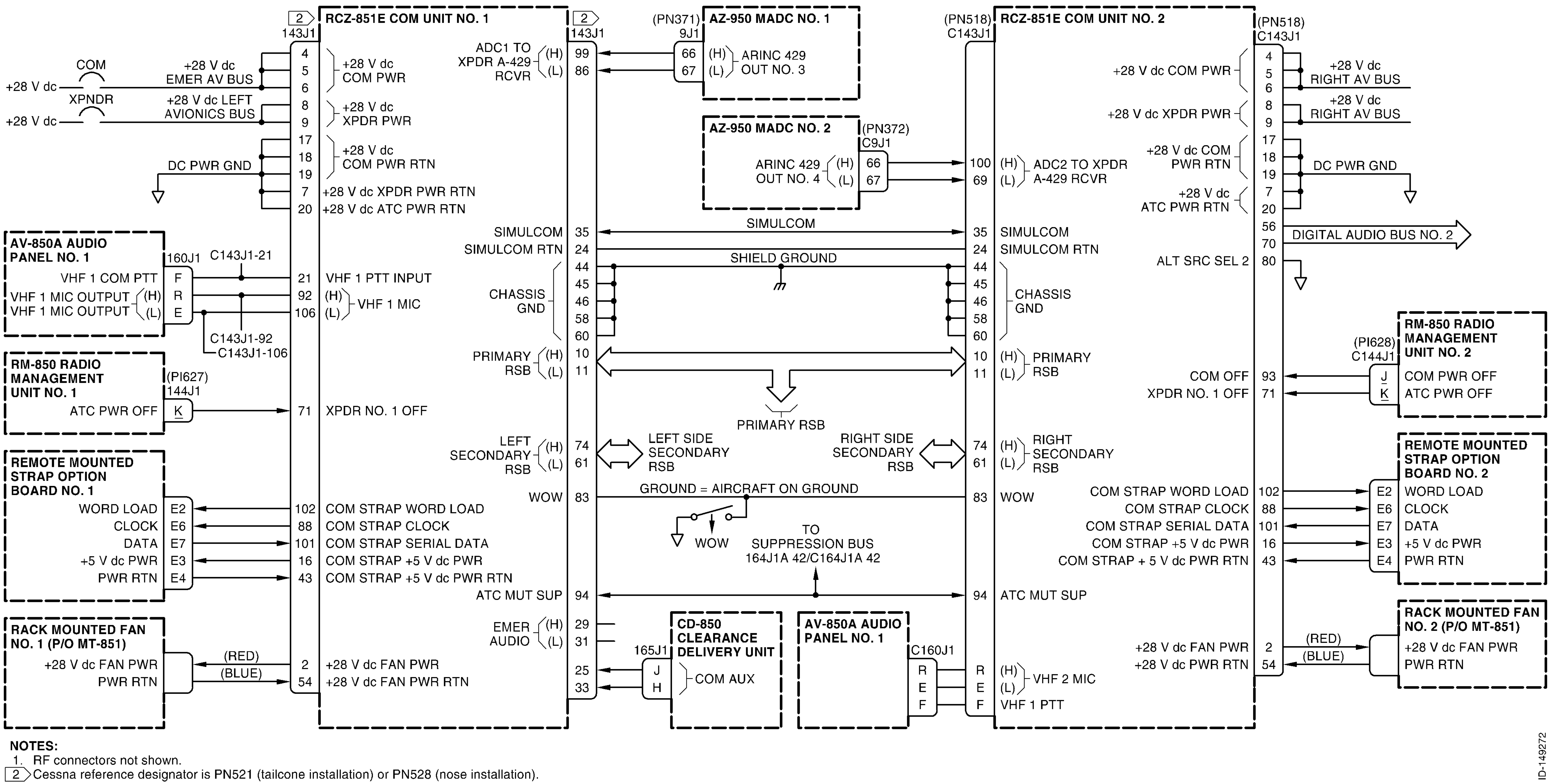
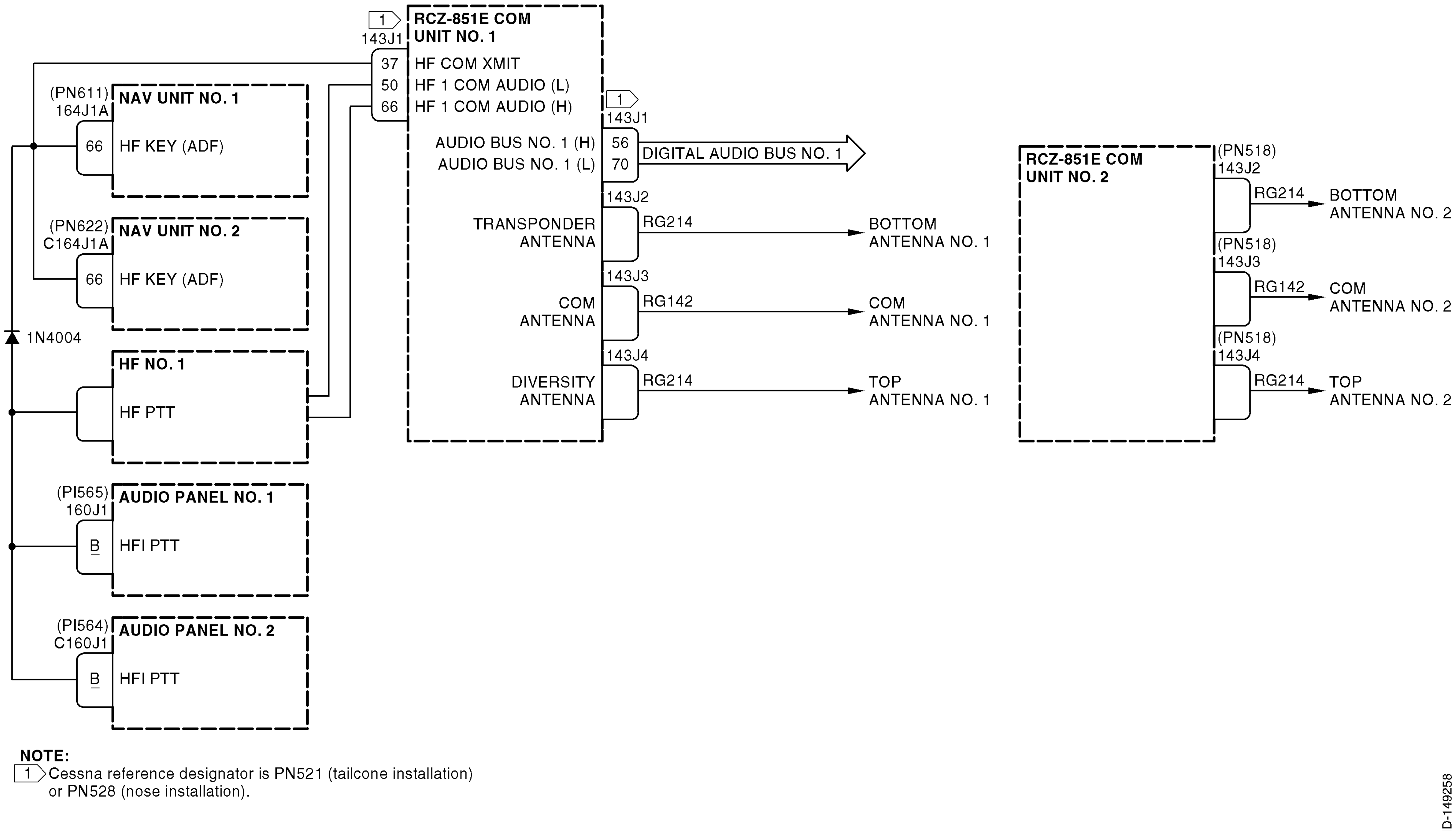


NOTES:
1. RF connectors not shown.
2 Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).

Figure 2-4-13 (Sheet 1). RCZ-851E Integrated COM Unit Interface Diagram



NOTE:
1 Cessna reference designator is PN521 (tailcone installation) or PN528 (nose installation).

Figure 2-4-13 (Sheet 2). RCZ-851E Integrated COM Unit Interface Diagram

G. RNZ-850/850B Integrated NAV Unit Interface

(1) Refer to Figure 2-4-14 for the RNZ-850/850B integrated NAV unit interface diagram.

(2) The common unit connections shown include power, ground, and RSB, all of which have been covered in previous sections.

(3) Connections between RCB to MLS and MLS to RCB instruct the cluster module that there is no MLS receiver on board, and therefore, the cluster module cannot file failure to communicate messages.

(4) The ADF antenna receives power and modulation signals from the ADF receiver through the cluster module. The signal from the antenna is via triaxial cable. The ADF antenna contains the self-test signal generator used during self-test procedures.

(5) During a cold start power-up, the cluster board sends word load and clock to the strap option board and receives data back. This data is sent to the modules via the RCB.

(6) The rack-mounted fan is controlled by the cluster module and is turned on when any module reports a temperature above the threshold. The threshold is different in each module. When the temperature drops below the threshold, the cluster module turns the fan off. The fan is not required for system operation.

(7) The mutual suppression bus goes to ground when any of the transmitters on the line is transmitting. This prevents the DME, TCAS, and transponders from interfering with each other during otherwise normal operation.

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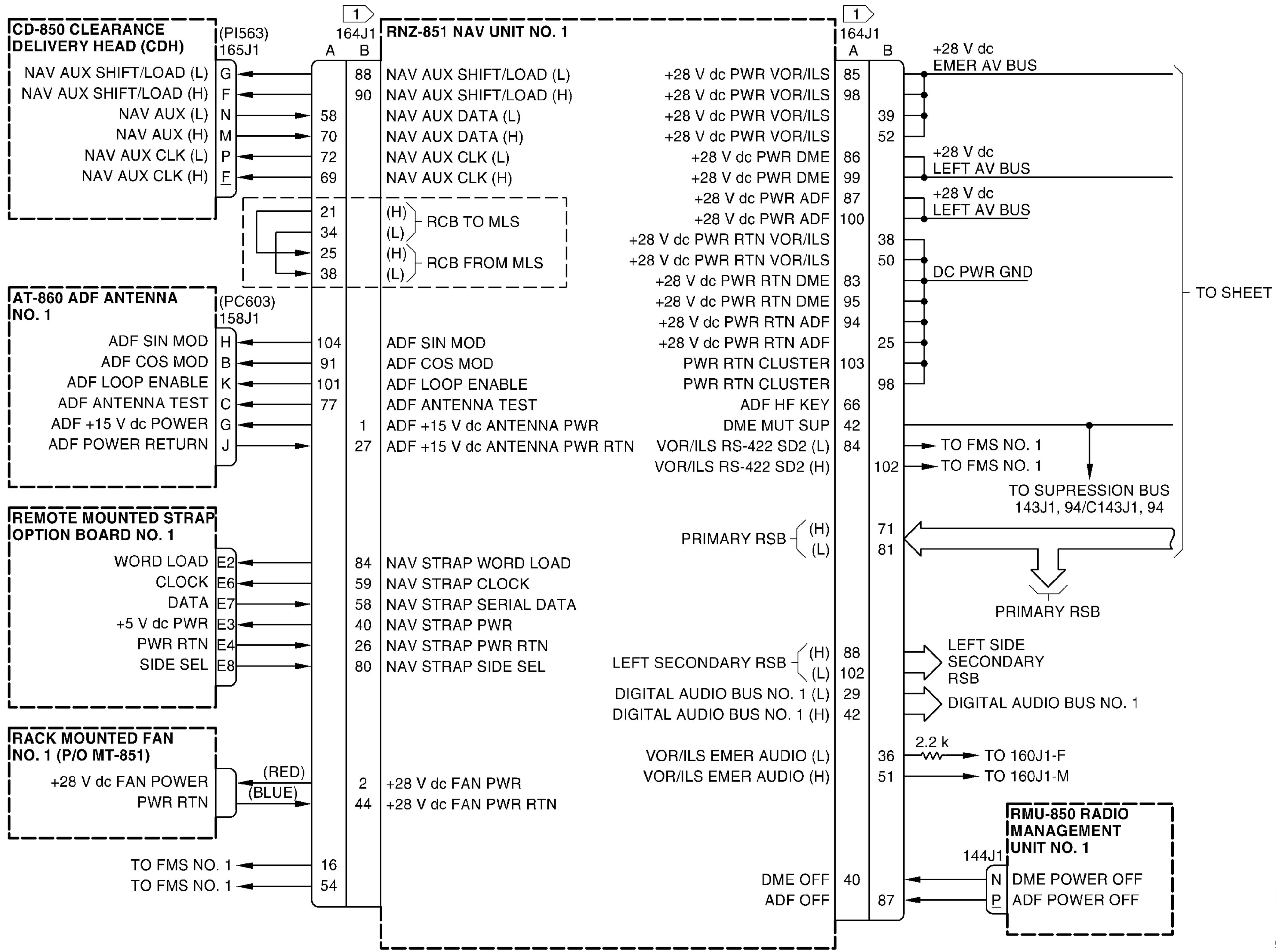

NOTES:
1. Cessna reference designator is PN611 (164J1A) and PN612 (164J1B) for tailcone installation, or PN622 (C164J1A) and PN623 (C164J1B) for nose installation.
2. Cessna reference designator is PN622 (C164J1A) or PN623 (C164J1B).

Figure 2-4-14 (Sheet 1). RNZ-850/850B NAV Unit Interface Diagram

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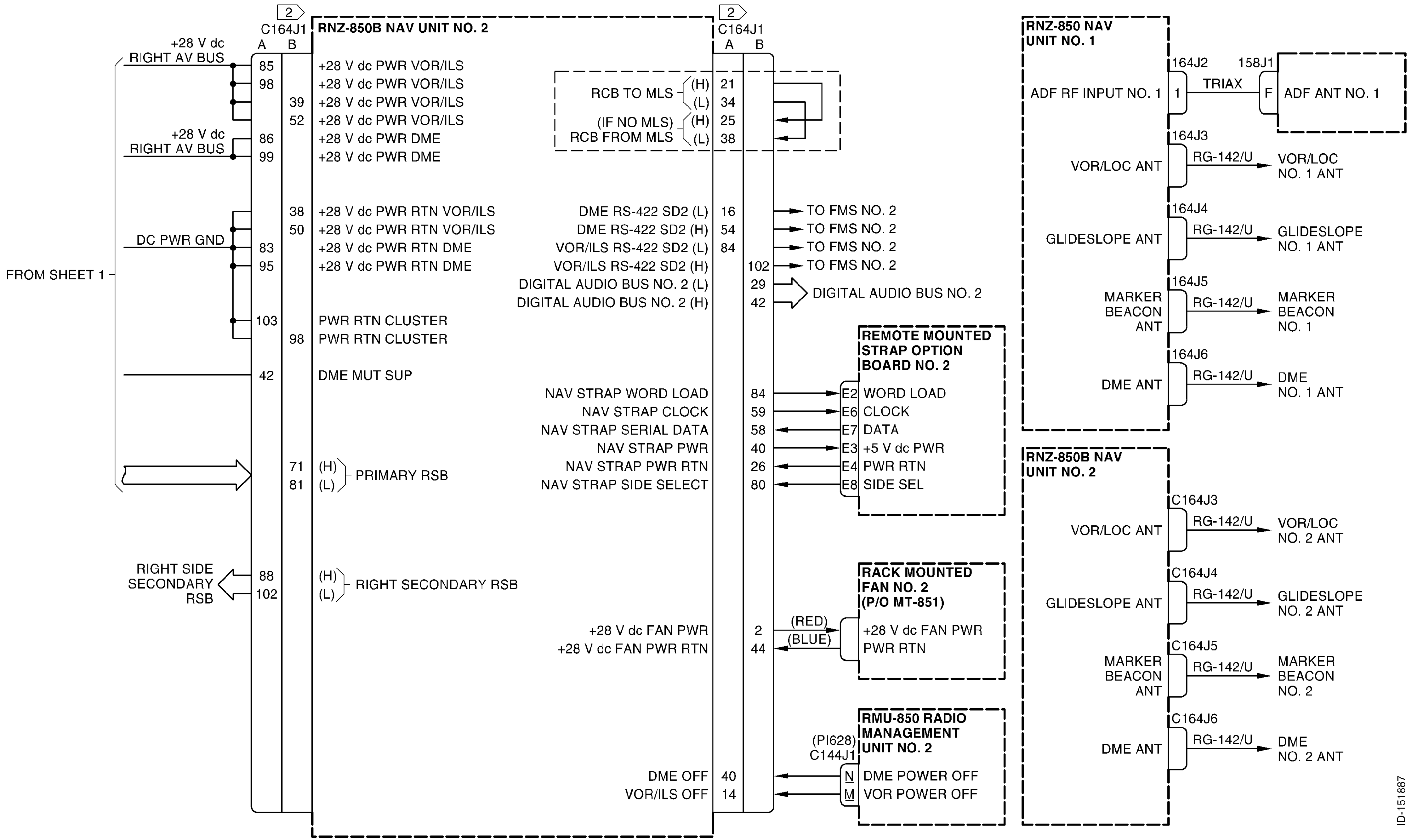

Figure 2-4-14 (Sheet 2). RNZ-850/850B NAV Unit Interface Diagram

4. Fault Monitoring

A. General

(1) Fault indications are presented on the PFD and the RMU. Refer to Figure 2-4-15 and Figure 2-4-16.

B. PFD Indications

(1) Figure 2-4-15 shows the fault indication as shown on the PFD.

(2) Loss of valid vertical deviation from the NAV receiver causes the following to occur:

- Removal of the vertical deviation pointer
- Scale to be a red **X**.

(3) Loss of valid lateral deviation from the NAV receiver causes the following to occur:

- Removal of the HSI lateral deviation pointer
- HSI lateral deviation scale to be a red **X**.

(4) Loss of valid distance information from the DME module causes the following to occur:

- Amber dash of the distance digital readout.

(5) Loss of valid bearing information from the NAV receiver causes the following to occur:

- Removal of the HSI lateral deviation pointer
- HSI lateral deviation scale to be a red **X**.
- Removal of the TO/FROM display
- Removal of the absolute bearing pointers.

Figure 2-4-15. PFD Radio System Failure Indications

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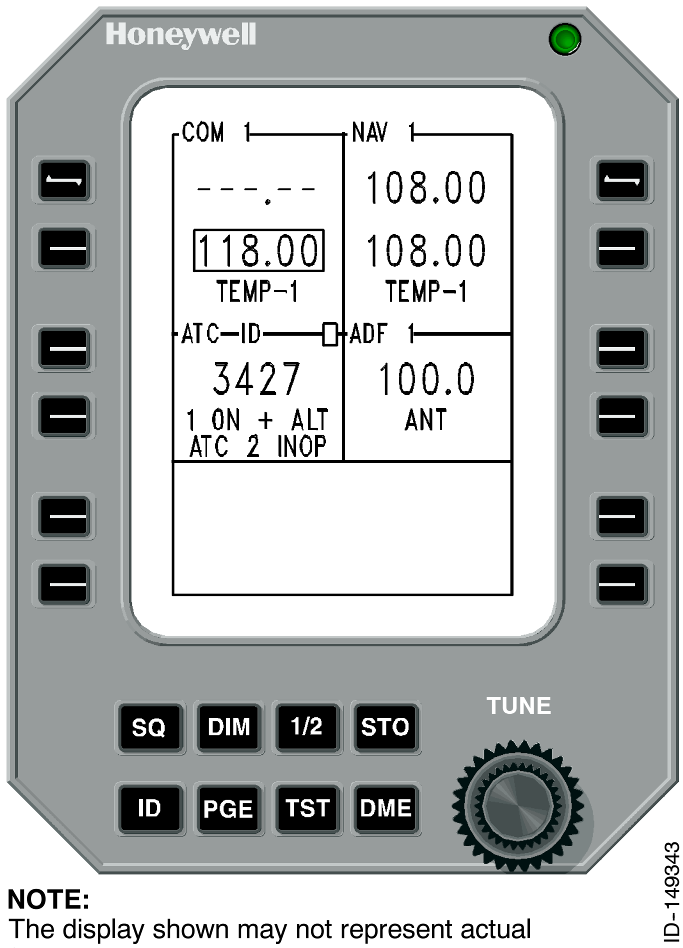
C. RMU Display

(1) Figure 2-4-16 shows the fault indication as shown on the RMU. Any failure of a module causes the RMU to remove the frequencies or operating commands associated with that particular function and replace them with dashes.

(2) If a transponder operating in the standby mode fails while the other transponder is active, a red ATC1 INOP or ATC2 INOP message appears on the bottom line in the transponder window on the RMU.



NOTE:
The display shown may not represent actual flight conditions.

Figure 2-4-16. RMU Failure Indications

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SECTION 2-5
FLIGHT GUIDANCE SYSTEM

1. Overview

A. General

(1) The PRIMUS 1000 flight guidance system employs two separate flight director systems. One is housed in the pilot's IC-615 IAC and the other is housed in the copilot's IC-615 IAC. The flight directors give computed steering commands to the autopilot and to the command bars on the PFDs. With the autopilot not engaged, the pilot can manually fly the steering command. With the autopilot engaged, the flight director computed steering commands are flown by the autopilot. The flight director supplies both lateral and vertical steering commands, and one of each can be active at the same time to control the aircraft. Other flight director modes can be armed to automatically become active at the proper time.

(2) The PRIMUS 1000 flight guidance system is a split processor system. The primary processor is used for the EFIS and flight director functions. The secondary processor supplies servo control of the aileron, elevator, rudder, and elevator trim. The secondary processor is not aware of flight director modes and does not change any gains as a function of flight director modes.

(3) The remote mounted FD1/FD2 switch lets the pilot select which flight director is active and coupled to the autopilot.

(4) Each flight guidance system is made up of the following LRUs:

- MS-560 mode selector
- IC-615 IAC
- PC-400 autopilot controller (common to both flight directors)
- DC-550 display controller
- RI-553 remote instrument controller (common to both flight directors)
- RI-552 remote instrument controller.

(5) The sensors used by the flight director are as follows:

- MADC
- Radio altimeter
- AHRS
- NAV and DME radios
- FMS.

(6) For the flight director to compute a steering command, the following has to be considered.

- What is the pilot's desired attitude/position?
- What is the aircraft's actual attitude/position?
- If there is a difference between desired and actual, correct for the difference, and control the speed at which the correction takes place.

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(7) Flight director modes use onside attitude, heading, and air data information for computations. Cross-side attitude data is used for monitoring only.

B. Flight Director Data Management

(1) The flight director only requires pitch and roll attitude for synchronizing the attitude command and for computing command bar outputs. The onside attitude data is used for synchronization and command bar computations when modes are selected. The IC-615 IAC uses the flight director attitude command to position the command bar on the attitude sphere.

(2) The flight director can couple to either SRN or LRN using the FMS, based on which is being displayed on the PFD. Each flight director uses onside displayed NAV data.

(3) The flight director uses the air data input as the reference for all vertical modes, except glideslope and gain programming. The altitude hold target, airspeed target, vertical speed target, and selected altitude are all computed by the IC-615 IAC.

C. Flight Director Couple Switching

(1) Flight director couple switching lets either the pilot's or copilot's flight director be coupled to the PRIMUS 1000 autopilot. This is accomplished by the remote-mounted FD1/FD2 button. The pilot's IC-615 IAC controls the state of the flight director couple switching.

(2) Flight director couple status determines which flight director is master for mode engagement. The noncoupled (slaved) flight director attempts to engage the same mode(s), as long as the appropriate valids and NAV sources are available. If the mode cannot be engaged on the slaved flight director, it remains in pitch hold and heading hold until such time as the mode can be entered automatically.

(3) Activation of the FD1/FD2 switch resets the selected flight director modes of both flight directors. The pilot must then re-engage the desired flight director modes.

D. Flight Director Mode Annunciator

(1) The master flight director annunciates the selected armed mode on its onside PFD and the cross-side flight director slaves to this display. When the mode is captured, the master PFD annunciates capture and the slaved PFD annunciates capture when the slaved flight director enters the capture mode.

(2) If the onside SG reversion function is activated on the master side, the flight director modes are reset. If the onside SG reversion function is activated on the side with a slaved flight director, the flight director modes on both flight directors remain active.

(3) If the IC bus becomes invalid, each flight director defaults to the master state, and the flight director mode annunciations are independently annunciated on their onside PFD.

(4) After an IC bus failure, it is impossible to couple the right side flight director to the autopilot. The right side flight director still accepts mode select inputs from its MS-560 mode selector and display mode annunciators on the PFD.

E. Master/Slave Air Data Target Switching

(1) The flight directors operate in a master/slave arrangement that tracks the air data targets, the heading select reference, and the selected mode annunciators on the PFD between the pilot's and copilot's systems. The position of the FD1/FD2 switch indicates which flight director is master. The master flight director computes the reference for the selected altitude, IAS hold target, Mach hold target, vertical speed mode reference, and VNAV parameters for both flight directors. This capability prevents vertical command bar splits between the master and slaved flight directors. When the master and slaved flight directors are in the same mode, the slaved flight director synchronizes to the targets computed by the master flight director.

(2) The slaved flight director only computes these reference parameters if the slaved flight director is in a different mode than the master flight director.

F. Flight Director Command Bar Logic

(1) The flight director command bar (either cross pointer or single cue) goes out of view for invalid data sources related to the mode.

G. ASEL Function

(1) The ASEL function consists of a set knob located on the MFD bezel controller. Each discrete movement of the knob causes a 100-ft change in the ASEL target. On power-up, the ASEL is invalid until the set knob is rotated. There also are ASEL light and horn warning discretes controlled by the IC-615 IAC.

2. Component Descriptions and Locations

A. IC-615 IAC

(1) Two IC-615 IACs are located in the nose compartment. Figure 2-5-1 shows a graphical view of the IC-615 IAC. Table 2-5-1 gives items and specifications particular to the computer.

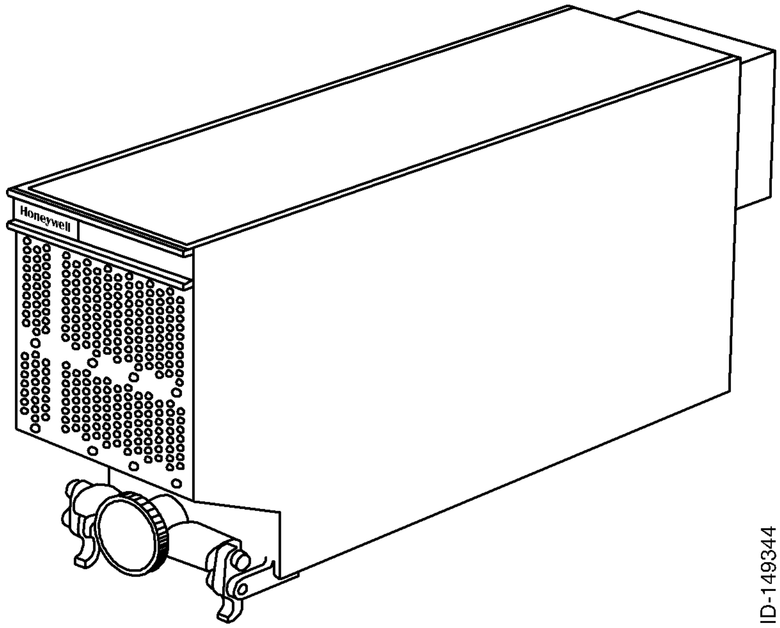

Figure 2-5-1. IC-615 IAC (FD Function)

Table 2-5-1. IC-615 IAC Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	7.62 in. (193.55 mm)
• Width	4.13 in. (104.90 mm)
• Length	16.45 in. (418.83 mm)
Weight (maximum):	
• With autopilot	15.5 lb (7.05 kg)
• Without autopilot	15.0 lb (6.82 kg)
Power requirements (with autopilot):	
• Continuous	28 V dc, 50 W (max)
• In-rush	28 V dc (0.5 sec), 200 W (max)
• Servo power	28 V dc, 210 W (max)/112 W (nom)
Power requirements (without autopilot):	
• Continuous	28 V dc, 50 W (max)
• In-rush	28 V dc (0.5 sec) 200 W (max)
User replaceable parts	
• Battery	HPN 7020116-1

Table 2-5-1. IC-615 IAC Leading Particulars (cont)

Item	Specification
Mating connectors (J1, J2)	ITT Cannon Part No. DPX2MA-A106P-A106P-33B-0001 NOTE: Sunbank backshell (4) required: Part No. J1560-12-2
Mounting	HPN 7017095-902

(2) The primary component of the flight director system is the IC-615 IAC. The pilot's IC-615 IAC is a symbol generator, flight director, and autopilot computer integrated into a single unit. The copilot's IC-615 is identical to the pilot's IC-615, except there is no autopilot function on the copilot's side. All aircraft sensors and navigation sources are connected directly to the IC-615 IAC, since all flight control functions reside inside this computer.

(3) Basic flight director modes are initiated by manual selection through the MS-560 mode selector. Once a mode is initiated, automatic transitions can occur from armed to active status or to another mode if the transition initiation requirements are met. The armed mode states only supply a visual indication (PFD annunciator) of mode status relative to a manual selection of some guidance modes, whereas active mode states give both visual mode status indications and pitch/roll steering commands to the PFD and the autopilot when engaged.

(4) Data used to compute guidance commands are consistent with that displayed on the PFD. This data includes the following:

- Displayed heading and heading flag valid
- Selected course and course error
- Selected heading and heading error
- Lateral and vertical path deviations and flag valids
- DME distance, tuned-to-NAV, and to-from status
- Middle marker data
- NAV source identification (tuned to localizer, VOR, LNAV)
- Lateral steering commands and flag valids

B. MS-560 Mode Selector

(1) Figure 2-5-2 shows a graphical view of the MS-560 mode selector. The mode selector is mounted in the glare shield in front of each pilot. Table 2-5-2 gives items and specifications particular to the mode selector.

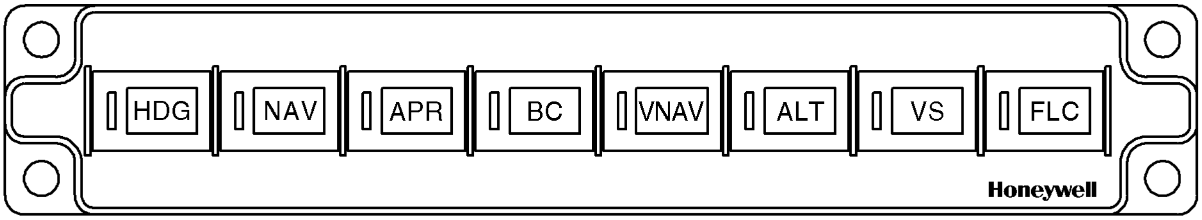

Figure 2-5-2. MS-560 Mode Selector

Table 2-5-2. MS-560 Mode Selector Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.125 in. (28.6 mm)
• Width	5.750 in. (146.0 mm)
• Length	3.380 in. 97.3 mm)
Weight (maximum)	0.80 lb (0.36 kg)
Power requirements:	
• Panel lighting	5 V ac or dc
• Mode annunciator	28 V dc
User replaceable parts:	
• Lamp, clear	HPN 7011974-3
• Lamp, blue white	HPN 7011974-4
Mating connector J1	M24308/2-283F with locking hardware M24308/125-9 and hood M85049146-2-3
Mounting	Hard mount

(2) The MS-560 mode selector lets the pilot make flight director lateral and vertical mode selections. The front panel has eight buttons. The buttons are connected to normally open switches. Each switch has a mode activation lamp inside. The switches make a momentary ground when pushed. Mode selections are sent to the respective DC-550 display controller, and from there to the IC-615 IACs.

(3) The lateral mode buttons are as follows:

- HDG (heading select)
- NAV (lateral navigation [SRN or LRN])
- APR (localizer and glideslope)
- BC (back course localizer).

(4) The vertical mode buttons are as follows:

- VNAV (vertical navigation)
- ALT (altitude hold)
- VS (vertical speed hold)
- FLC (flight level change).

C. DC-550 Display Controller

(1) The DC-550 display controller is mounted in the instrument panel next to the pilot's and copilot's PFD. Figure 2-5-3 shows a graphical view of the DC-550 display controller. Two display controllers are located in the glareshield. Table 2-5-3 gives items and specifications particular to the controller.

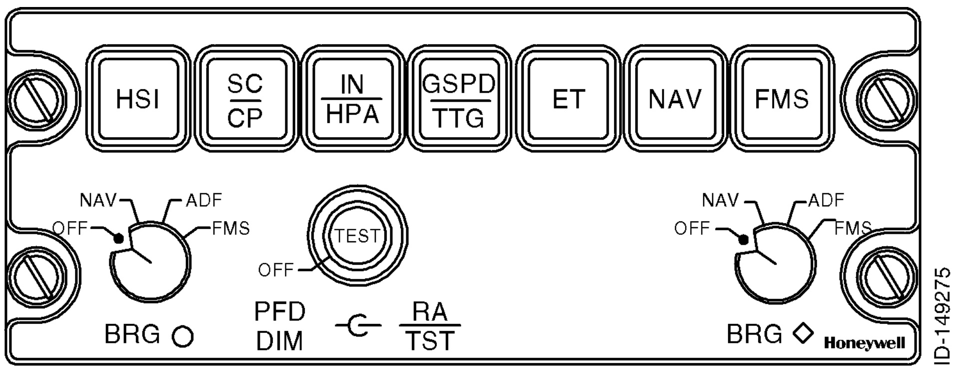

Figure 2-5-3. DC-550 Display Controller

Table 2-5-3. DC-550 Display Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	2.25 in. (57.15 mm)
• Width	5.75 in. (146.05 mm)
• Length	6.87 in. (174.50 mm)
Weight (maximum)	2.0 lb (0.91 kg)
Power requirements:	
• Primary	28 V dc, 5.0 W (max)
• Lighting	5 V ac, 5.0 W (max)

Table 2-5-3. DC-550 Display Controller Leading Particulars (cont)

Item	Specification
User replaceable parts:	
• Knobs:	
– BRG ○ (setscrew A)	HPN 7009437
– BRG ◇ (setscrew A)	HPN 7009437
– RA (setscrew B)	HPN 7018748-1
– Test button HUB (setscrew B)	HPN 7009644-3
• Setscrews:	
– A (multispline, 2-56 x 1/8 in., cup point)	HPN 2500148-64
– B (multispline, 4-40 x 3/16 in., cup point)	HPN 2500148-130
Mating connector J1	MS27473E20-B35SB
Mounting	Standard Dzus rail

(2) For the flight director function, the DC-550 display controller supplies a data acquisition function for the MS-560 mode selector and RI-553 remote instrument controller. This data is collected and then transmitted to the IC-615 IAC on a two-wire digital bus.

D. RI-553 Remote Instrument Controller

(1) The RI-553 remote instrument controller is mounted in the bottom of the pedestal. The RI-553 remote instrument controller lets the pilot select heading and course references for lateral flight director modes. The front panel has a single HEADING knob and two COURSE knobs. The knobs are connected to rotary switches that have 16 positions and give a quadrature greycode output. Operation of the knob lets the display increment one unit for each click of knob rotation. Selections are routed to the DC-550 display controllers, and from there to both IC-615 IACs. Figure 2-5-4 shows a graphical view of the RI-553 remote instrument controller. Table 2-5-4 gives items and specifications particular to the controller.

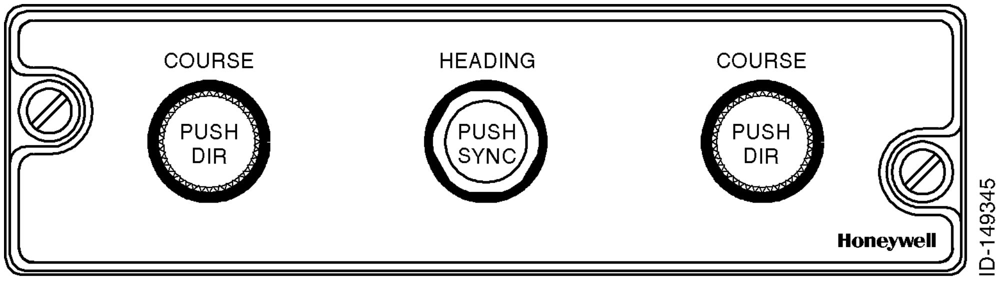

Figure 2-5-4. RI-553 Remote Instrument Controller

Table 2-5-4. RI-553 Remote Instrument Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.50 in. (38.10 mm)
• Width	5.75 in. (146.05 mm)
• Length	1.01 in. (25.65 mm)
Weight (maximum)	0.80 lb (0.36 kg)
Power requirements:	
• Panel lighting	5 V dc, 21.2 W (max)
User replaceable parts:	
• Knobs:	
- COURSE (setscrew A)	HPN 7009644-1
- HEADING (setscrew A)	HPN 7009681-1
- COURSE PUSH DIR (setscrew B)	HPN 7015342-16
- HEADING PUSH SYNC (setscrew B)	HPN 7015342-7
• Setscrews:	
- A (multispline, 4-40 x 1/8 in., cup point)	HPN 2500148-128
- B (multispline, 2-56 x 1/8 in., cup point)	HPN 2500148-64
Mating connector J1	MS27473E14A-35SC
Mounting	Standard Dzus rail

E. RI-552 Remote Instrument Controller

(1) The RI-552 remote instrument controller is mounted in the bottom of the pedestal. The RI-552 remote instrument controller lets the copilot select symbol generator reversion (SG REV) and altitude preselect (ALT SEL). The front panel has a single ALT SEL knob and a single SG REV knob. Selections are routed to the DC-550 display controllers, and from there to both IC-615 IACs. Figure 2-5-5 shows a graphical view of the RI-552 remote instrument controller. Table 2-5-5 gives items and specifications particular to the controller.

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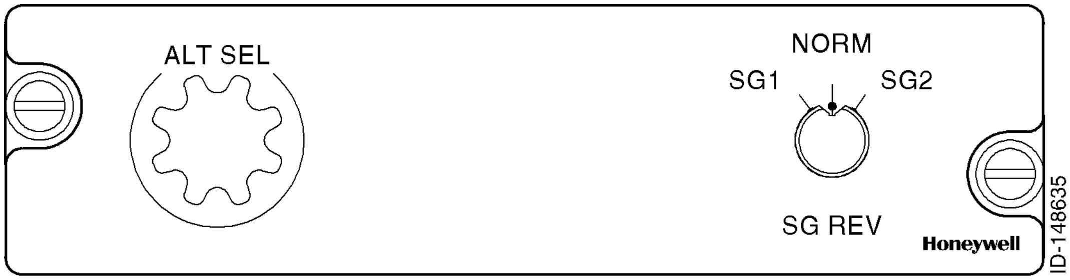

Figure 2-5-5. RI-552 Remote Instrument Controller

Table 2-5-5. RI-552 Remote Instrument Controller Leading Particulars

Item	**Specification**
Dimensions (maximum):	
• Height	1.50 in. (38.10 mm)
• Width	5.75 in. (146.05 mm)
• Length	1.01 in. (25.65 mm)
Weight (maximum)	0.80 lb (0.36 kg)
Power requirements:	
• Panel lighting	5 V dc, 21.2 W (max)
User replaceable parts:	
• Knobs:	
- ALT SEL	HPN 7019971
- SG REV	HPN 7011875-902
• Setscrew:	
- Multispline, 2-56 x 1/8 in., cup point	HPN 2500148-64
Mating connector J1	MS27473E14A-35SC
Mounting	Standard Dzus rail

F. PC-400 Autopilot Controller

(1) The PC-400 autopilot controller gives the flight director pitch wheel inputs for specified vertical flight director modes and a low bank angle selection for the heading select mode only. The other functions of the controller relate to the autopilot and yaw damper operation and are discussed in the applicable chapters. The controller is located on the pedestal. Figure 2-5-6 shows a graphical view of the PC-400 autopilot controller. Table 2-5-6 gives items and specifications particular to the controller.

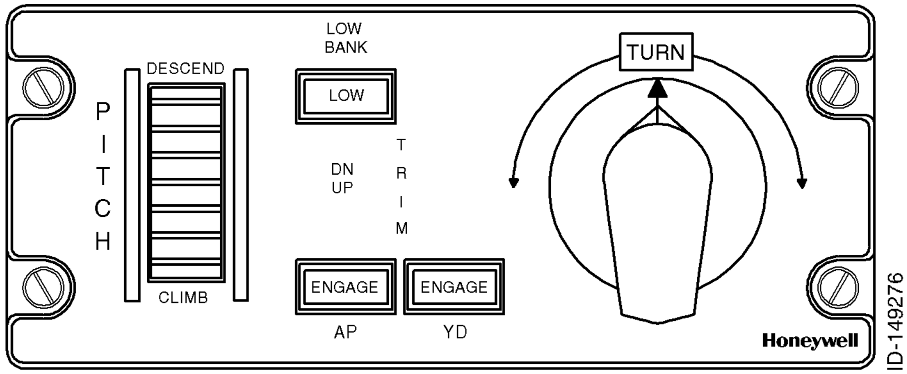

Figure 2-5-6. PC-400 Autopilot Controller

Table 2-5-6. PC-400 Autopilot Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	2.625 in. (6.67 cm)
• Width	5.750 in. (14.60 cm)
• Length	6.150 in. (15.62 cm)
Weight (maximum)	1.6 lb (0.73 kg)
Power requirements:	
• Instrument lighting	5 V ac or dc
• Mode switches	28 V dc
User replaceable parts:	
• Knob, turn	HPN 337136-1
• Setscrew, bottom (hex socket, 8-32 x 5/8 in., cup point)	HPN 0455-284
• Setscrew, side (hex socket, 8-32 x 3/16 in., cup point)	HPN 0455-274
• Lamp, clear (type 7341)	HPN 0635-22
Mating connector J1	MS3126F20-41S
Mounting	Standard Dzus rail

3. Operation

A. Flight Director Functions

(1) The major flight director functions of the IC-615 IAC are as follows:

- PFD command bar
- GS capture
- GS track
- GS gain programming
- Lateral beam sensor (LBS)
- LOC/BC capture
- LOC/BC track
- TAS gain programming
- Vertical beam sensor (VBS)
- VOR capture
- VOR track
- VOR over station sensor (OSS)
- VOR after over station sensor (AOSS).

(2) PFD Command Bars

(a) When a flight director steering command is applied to the command bar input, the bar (either cross-pointer or single cue) moves left or right (roll), or up and down (pitch). This gives the required visual command for the pilot to maneuver the aircraft in the proper direction to reach and maintain the desired flightpath.

(b) If the information required to fly a lateral or vertical flight director mode becomes invalid, the mode either cancels or the command cue goes out of view, dependent on what went invalid.

(3) GS Capture

(a) The conditions necessary for GS capture are as follows:

- The glideslope is valid.
- The glideslope is armed.
- The localizer mode is captured.
- The GS deviation is less than 2 dots.
- Either of the following is satisfied:
  - The vertical beam sensor has tripped.
  - The GS deviation is less than 20 mV.

(4) GS track

(a) GS track occurs after the flight director has captured the vertical path and is tracking the beam. The track phase provides for tighter flying of the GS beam. The track mode occurs after the GS is captured plus 15 seconds.

(b) The conditions required for glideslope track are as follows:

- GS is captured plus 15 seconds.
- The localizer portion of the approach is in the track phase.
- The GS deviation is less than 37.5 mV.
- The vertical deviation rate is less than 10 ft/s.
- The radio altitude is less than 1,200 ft.

(5) GS Gain Programming

(a) Glideslope gain programming begins after the vertical beam sensor trips. Gain is programmed as a function of radio altitude. If the radio altimeter is invalid, gain programming occurs at glideslope capture and is controlled by a height above runway estimator. The value estimated is a function of glideslope capture, glideslope track, and the middle marker. At glideslope capture, the height is estimated at 1,200 ft. At glideslope track and the passing of the middle marker, the height is 250 ft. If the MADC is not valid or the TAT probe fails, the airspeed is preprogrammed at 120 knots.

(6) LBS

(a) When flying to intercept the VOR, LOC, or BC beam, the LBS is tripped as a function of beam deviation, course error, TAS, and DME (if the DME is available and not in HOLD). In the LOC mode, the course error is compared with the beam deviation signal to determine the LBS trip point. When the LBS trips, the flight director commands a turn away from the desired VOR radial or runway to decrease closure rate and capture the beam. If the intercept angle to the beam center is very shallow, the LBS does not trip until the aircraft is near the beam center. For this reason, an override on the LBS occurs when the beam deviation reaches the specified minimum. When this occurs, the aircraft turns into the beam initially to increase closure rate.

(7) LOC/BC CAP

(a) LOC and BC capture occurs when the following conditions are met:

- LOC and BC are armed plus 1 second.
- Either of the following occurs:
  - The lateral beam sensor has tripped.
  - The beam deviation is less than 0.75 degrees.

(8) LOC/BC Track

(a) The localizer and back course track signify that the aircraft is on beam center and the crosswind washout correction can take place.

(b) The track phase occurs when the following conditions are met:

- LOC or BC is captured plus 4 seconds.
- The localizer beam rate is less than 30 ft/s.
- The localizer beam deviation is less than 20 mV.
- The aircraft bank angle is less than 6 degrees.

(9) TAS Gain Programming

(a) TAS gain programming is used on the heading select, course select, pitch wheel command, air data commands (except IAS), and GS deviation. TAS gain programming is used to achieve the same aircraft response to flight guidance commands, regardless of the altitude and speed of the aircraft. The TAS computation is derived from altitude, airspeed, and outside air temperature.

(10) VBS

(a) The VBS determines the point of glideslope capture using a number of inputs. The VBS is armed when LOC capture occurs. The VBS trips as a function of VS, TAS, radio altitude, and glideslope deviation. The VBS trips when deviation is less than 0.5 degrees on the ILS pointer and a capture sensor is satisfied. The capture sensor combines vertical speed, change of beam deviation, and radio altitude to determine the best capture point. In the event that the aircraft is paralleling the beam (no beam closure rate), the VBS trips at a vertical deviation less than 0.1 degree. This resets the previously selected pitch mode and changes the aircraft attitude to capture the glideslope beam.

(11) VOR CAP

(a) VOR capture occurs when the following conditions are satisfied:

- The VOR mode has been armed plus 1 second of elapsed time.
- The lateral beam sensor has tripped.

(12) VOR Track

(a) VOR track occurs as the aircraft is established on beam center and the following conditions are met:

- The VOR mode is captured plus 90 seconds
- The lateral deviation rate is less than 50 ft/s.
- The aircraft bank angle is less than 6 degrees.

(b) At this time, crosswind correction is allowed to start.

(13) VOR OSS

(a) The OSS is used to detect the erratic radio signals encountered in the area above the VOR transmitter. When these radio signals reach a predetermined level or deviation, they are no longer useful and OSS eliminates them from the control signal. OSS is computed when, with DME valid, a 30-degree VOR station zone of confusion is assumed and calculated, using barometric altitude for VOR navigation. During VOR approach, the formula computes the zone with radio altitude. If the radio altimeter is invalid, the computation assumes a 2,500-ft altitude for VOR approach computations.

(14) VOR AOSS

(a) During the period when neither the OSS control function nor the navigation on course (NOC) function are operational, the system operates in AOSS. AOSS permits large bank angles so that before NOC controls the aircraft, a larger course correction can be made.

B. Flight Director Lateral (Roll) Channel Functional Operation

(1) Figure 2-5-7 shows the LRU interface for the pilot's side flight director lateral modes. Figure 2-5-8 shows the LRU interface for the copilot's side flight director lateral modes.

(2) LRU Lateral Functions

(a) The function of each LRU for each lateral mode is discussed in the paragraphs that follow.

(b) AHRS

1 The onside AHRS supplies the ARINC 429 data that provide actual aircraft roll attitude, heading, angular rates, and aircraft accelerations for display on the PFD, as well as for the flight director lateral modes.

(c) AZ-950 MADC

1 The onside AZ-950 MADC supplies the onside IC-615 IAC with an ARINC 429 input of air data values, including TAS. The TAS signal is used in all lateral flight director modes for gain programming. The response of the aircraft should feel the same to the pilot regardless of the aircraft's airspeed and altitude. Less flight control surface deflection at high speed and high altitude is required to complete a maneuver than it does at low speed and low altitude. Therefore, changing signal gain as a function of TAS achieves this result.

2 If the AZ-950 MADC become invalid, a fixed bias TAS of 120 knots is used in the IC-615 IAC. The default value of TAS is set for the approach speed region of flight.

(d) SRN Radios

1 The SRN radios supply navigation data, DME, and marker beacon data to the IC-615 IACs across the radio system bus. The DME signal is used in the VOR and VOR approach modes to gain program the VOR signal as a function of the aircraft approaching or departing the VOR station.

(e) LRN Unit (Not supplied by Honeywell)

1 The LRN unit supplies an ARINC 429 composite steering command output to the IC-615 IACs. Gain programming for the composite steering command signal is done in the LRN unit. The signal from the LRN to the IC-615 IACs represent the computed desired track over the ground, from the last sequenced waypoint to the TO waypoint in the active flight plan.

(f) Radio Altimeter

1 The radio altimeter provides an analog output of absolute altitude above the terrain. This signal is used by the flight director to gain program flight director approach modes. Gain programming is required due to the directional qualities and beam convergence characteristics of the localizer and glideslope antennas.

2 As the aircraft approaches the runway, the localizer signal appears to get stronger and the beam appears to get narrower. By reducing the gain on the signal as a function of the change in radio altitude, the computed steering command does not take the aircraft out of the localizer beam envelope and reduces S turning.

3 If the radio altimeter is invalid, localizer gain programming starts as a function of GS capture and runs down as a function of TAS and time. At the middle marker, gain programming is synchronized to a preset value.

(g) MS-560 Mode Selector

1 The MS-560 mode selector lets the pilot engage/disengage both lateral and vertical flight director modes. Each MS-560 mode selector transmits button data as two-wire, greycode formatted data to its onside DC-550 display controller. The DC-550 display controller transmits the button data to its onside IC-615 IAC over a DC/SG bus. The mode selector receives a ground input from its onside IC-615 IAC to light the mode button for an armed or capture condition.

(h) RI-553 Remote Instrument Controller

1 The RI-553 remote instrument controller gives both pilots the ability to set the heading select bug for the heading select mode, as well as setting the selected course in the VOR, VOR approach, and localizer modes. The output from the RI-553 remote instrument controller is two-wire greycode formatted and transmitted to each DC-550 display controller. Each display controller transmits the data to its onside IC-615 IAC over a DC/SG bus.

(i) RI-552 Remote Instrument Controller

1 The RI-552 remote instrument controller lets the copilot select symbol generator reversion (SG REV) and altitude preselect (ALT SEL). The front panel has a single ALT SEL knob and a single SG REV knob. Selections are routed to the DC-550 display controllers, and from there to both IC-615 IACs.

(j) DC-550 Display Controller

1 The DC-550 display controller supplies an RS-422 digital bus interface (DC-SG bus) between itself and its onside IC-615 IAC. Heading bug set and selected course inputs are routed through the DC-550 display controller, as well as flight director button mode selections, to be put on the digital bus interface to its onside IC-615 IAC.

(k) PC-400 Autopilot Controller

1 The only function on the PC-400 autopilot controller for lateral flight director modes is the low bank button. The low bank button is for the heading select mode only. When active, it reduces the maximum bank angle in the mode from 27.5 to 14 degrees.

(l) IC-615 IAC

1 The IC-615 IAC performs the following, as a function of whichever lateral mode is active.

2 Heading Select Mode

a When the heading select mode is activated, the flight director processor in the IC-615 IAC compares actual aircraft heading against desired aircraft heading, as determined by the position of the heading select bug on the coupled side PFD. The difference is the heading select error signal.

b With the autopilot not engaged, the heading select error signal is presented on the master PFD flight director command bar as a steering command for the pilot to bank the aircraft and fly toward the heading bug. Roll attitude data from the onside AHRS is used with the error signal in the flight director processor to center the command cue when the proper bank angle has been achieved.

c As the aircraft approaches the selected heading, the heading error signal gets smaller in size, and the roll attitude signal commands the pilot to roll the aircraft to a wings-level condition. With the aircraft flying the selected heading, the following conditions exist:

- The heading select error is zero.
- The flight director command bar is centered.
- The control wheel is centered.
- The aircraft is maintaining the selected heading.

d With the autopilot engaged, the coupled-side flight director processor generates the commands as stated previously and sends them to the autopilot for automatic flightpath steering. On the coupled-side PFD, the flight director command bar can move a little out of center and then return. With the autopilot satisfying the flight director steering command, the command cue is centered.

e Input data used by the heading select control law includes selected heading, actual heading, TAS, and roll attitude.

3 Low Bank Submode

a The low bank submode lets the pilot select reduced bank-angle limits for the heading select mode. The mode is selected by pushing the low bank (LOW) button on the PC-400 autopilot controller. When active, the bank angle limit is reduced from 27.5 to 14 degrees. The mode is only annunciated while the heading select mode is active, but remains selected and reactivates/annunciates if heading select is made active again. The low bank mode is canceled by pushing the LOW button while the annunciator is lit.

b Low bank mode is automatically activated by climbing through 34,000 ft. Automatic canceling of low bank occurs descending through 33,750 ft.

4 VOR/VOR Approach Mode

a When the VOR mode is armed, the flight director processor compares actual aircraft heading against selected aircraft course, as determined by the position of the course select pointer on the master PFD. The difference is the course error signal.

b The LBS is computing when to capture the VOR beam. At VOR capture, the heading select mode is dropped and the flight director processor generates a command to bank the aircraft and get aligned on the VOR beam center.

c With the autopilot not engaged, the VOR error signal is presented on the master PFD flight director command bar as a computed steering command for the pilot to bank the aircraft and fly toward the selected course. Roll attitude data from the onside AHRS is used with the error signal in the flight director processor to center the command cue when the proper bank angle has been achieved.

d As the aircraft approaches the selected course, the course error signal gets smaller in size and the roll attitude signal commands the pilot to roll the aircraft to a wings-level condition. With the aircraft flying the selected course, the following conditions exist:

- The course select error is appropriate to maintain VOR beam center.
- The radio deviation is zero.
- The flight director command bar is centered.
- The control wheel is centered.
- The aircraft is tracking the selected VOR radial.

e With the autopilot engaged, the flight director processor generates the commands as stated above, but sends them to the autopilot for automatic flightpath steering. On the master PFD, the flight director command bar can move a little out of center and then return. With the autopilot satisfying the flight director steering command, the flight director command bar is centered.

f As the aircraft flies over the VOR station, the flight director processor monitors for entry into the zone of confusion above the VOR station. With DME and composite air data flags valid, the extent of the zone of confusion is determined by multiplying the buffered barometric altitude by 1.1547 (1/cosine of 30 degrees). This is the estimated slant range of the 30-degree zone from the VOR station at the given aircraft barometric altitude. The filtered DME distance (aircraft slant range to the VOR) is then subtracted from the computed slant range of the 30-degree zone of confusion. If the difference is greater than or equal to zero, then the slant range lies within the zone of confusion and the flight director considers itself within the zone of confusion.

g With DME not valid, or not available, the system monitors beam deviation and beam rate for the OSS function. Beam deviation must be greater than 75 mV and beam rate of change greater than 7.5 mV/s. When radio deviation drops below 75 mV, a 20-second clock is started (4 seconds in VAPP). At the end of this time, the radio input is again made part of the VOR equation. The time delay ensures the aircraft has cleared the zone of confusion.

h The input data used by the VOR control law includes selected course, VOR bearing, DME, TAS, baro corrected altitude, and roll attitude.

5 Localizer/Back Course Modes

a When the localizer mode is armed, the flight director processor compares actual aircraft heading against selected aircraft course, as determined by the position of the course select pointer on the master PFD. The difference is the course error signal.

b The LBS is computing when to capture the localizer beam. At localizer capture, the heading select mode is dropped and the flight director processor generates a command to bank the aircraft and get aligned on the localizer beam.

c With the autopilot not engaged, the localizer error signal is presented on the master PFD flight director command bar as a computed steering command for the pilot to bank the aircraft and fly towards the selected course. Roll attitude data from the AHRS is used with the error signal in the flight director processor to center the command cue when the proper bank angle has been achieved.

d As the aircraft approaches the selected course, the localizer error signal gets smaller in magnitude, and the roll attitude signal commands the pilot to roll the aircraft to a wings-level condition. With the aircraft tracking the localizer beam, the following conditions exist:

- The course select error is appropriate to maintain localizer beam center.
- The radio deviation is zero.
- The command cue is centered.
- The control wheel is centered.
- The aircraft is tracking the localizer beam.

e With the autopilot engaged, the flight director processor generates the commands as stated above and sends them to the autopilot for automatic flightpath steering. On the master PFD, the command cue can move a little out of center and then return. With the autopilot satisfying the flight director steering command, the command cue is centered.

6 LNAV Mode

a When the LNAV mode is active, the flight director processor in the IC-615 IAC receives computed steering commands from the LRN unit over an ARINC 429 bus. These commands let the flight director fly the active flight plan as displayed on the LRN CDU.

b On the master PFD, the course select pointer is now a desired track pointer and is positioned automatically by the LRN.

c The input data used by the LNAV control law includes the composite steering command from the LRN unit and roll attitude from the AHRS.

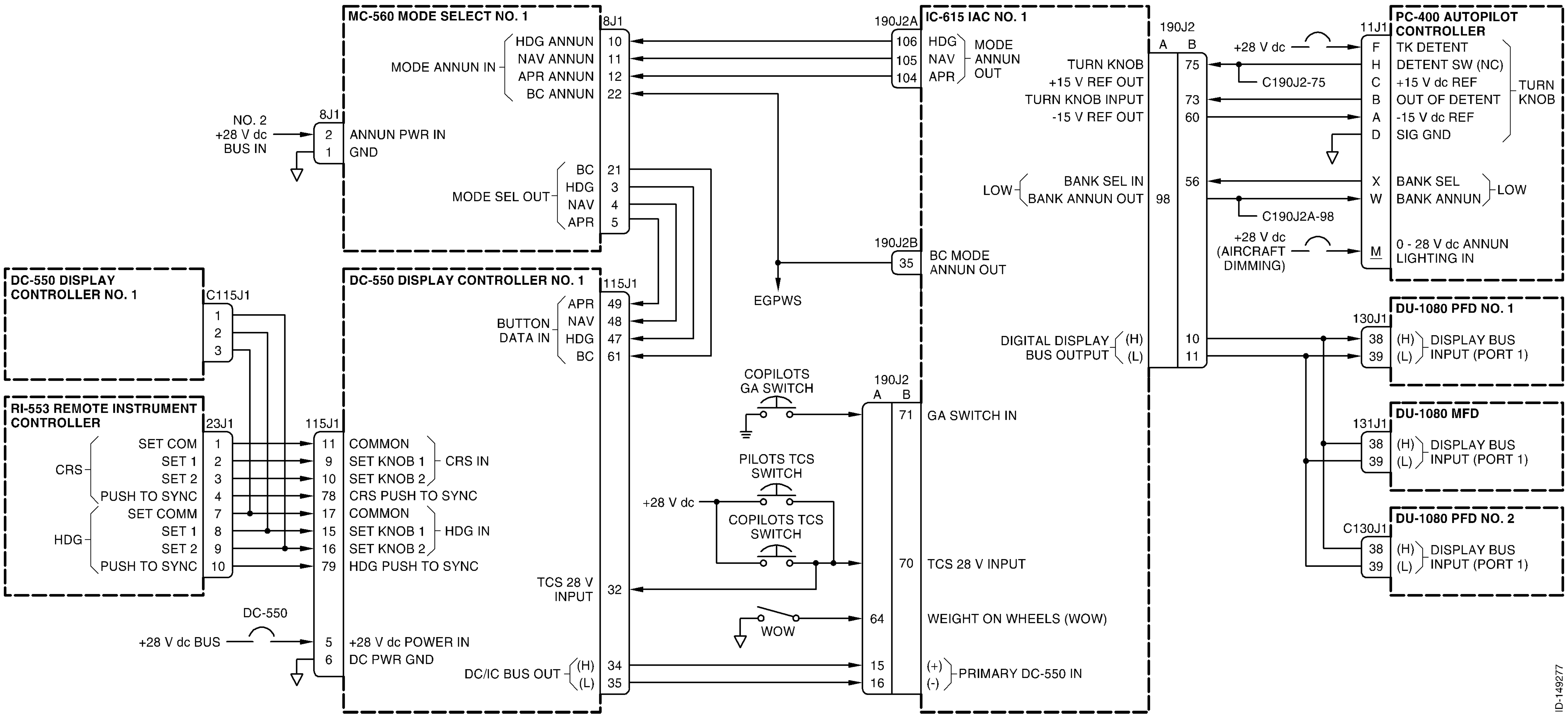

Figure 2-5-7 (Sheet 1). Flight Director Lateral Mode Interface - Pilot's Side

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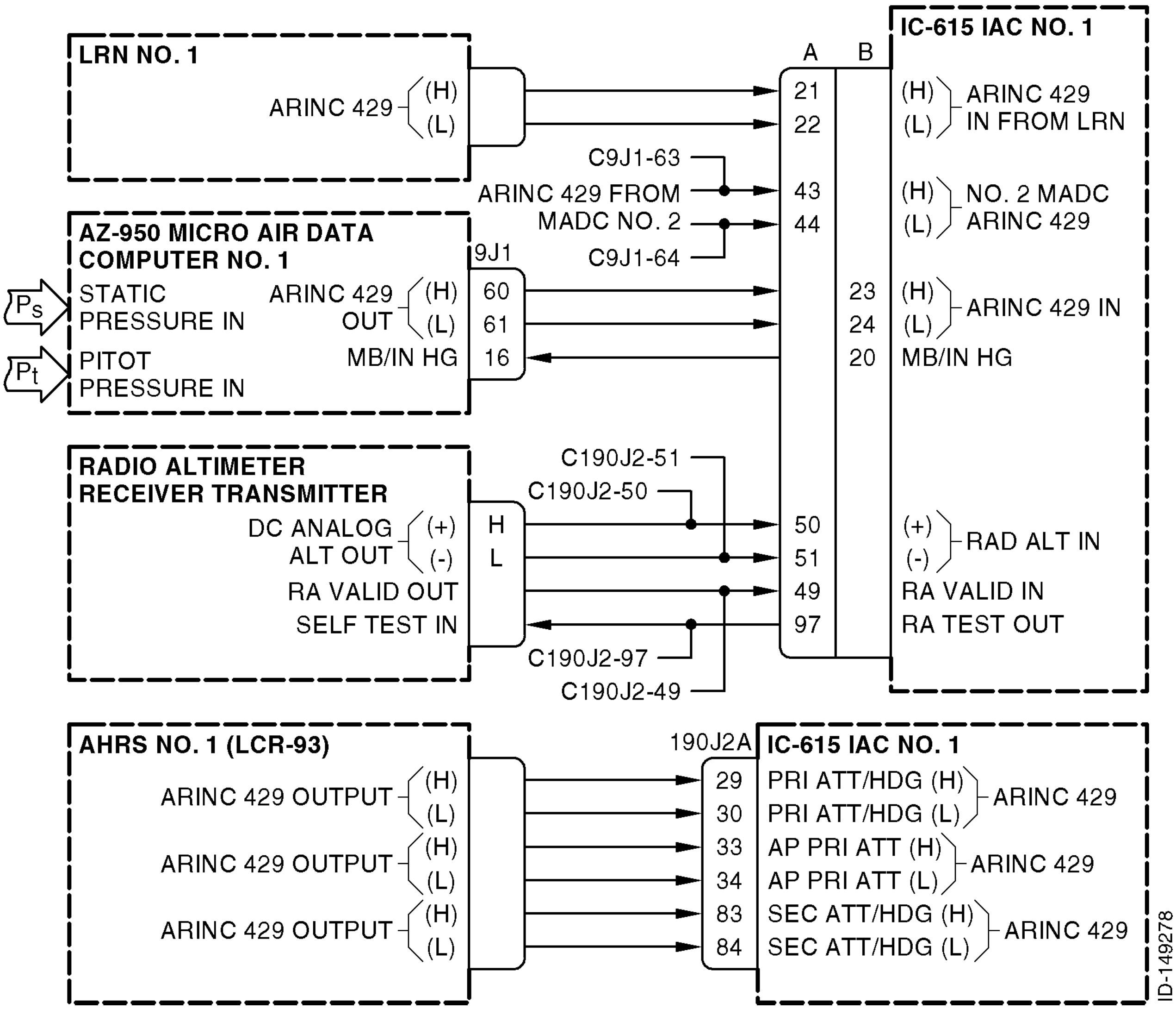

Figure 2-5-7 (Sheet 2). Flight Director Lateral Mode Interface - Pilot's Side

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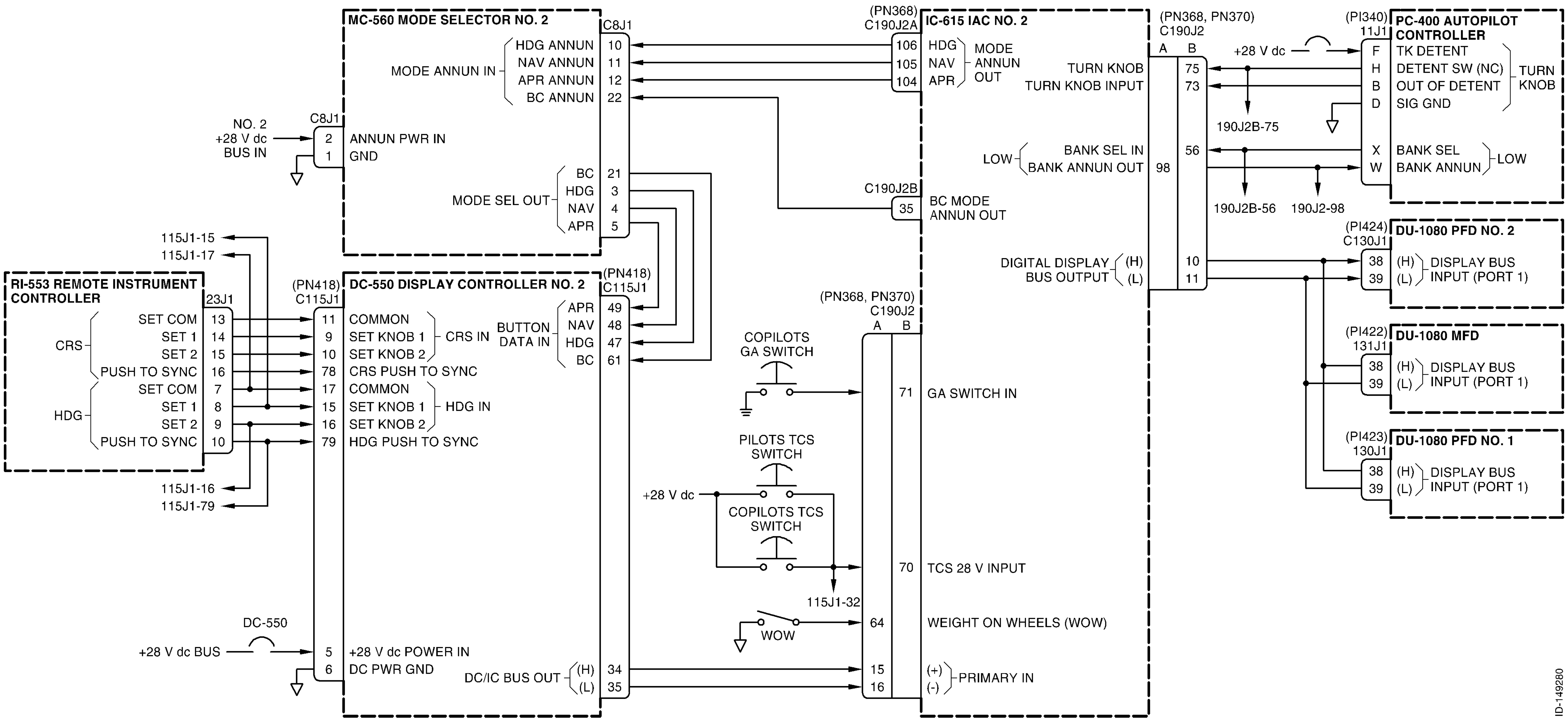

Figure 2-5-8 (Sheet 1). Flight Director Lateral Mode Interface - Copilot's Side

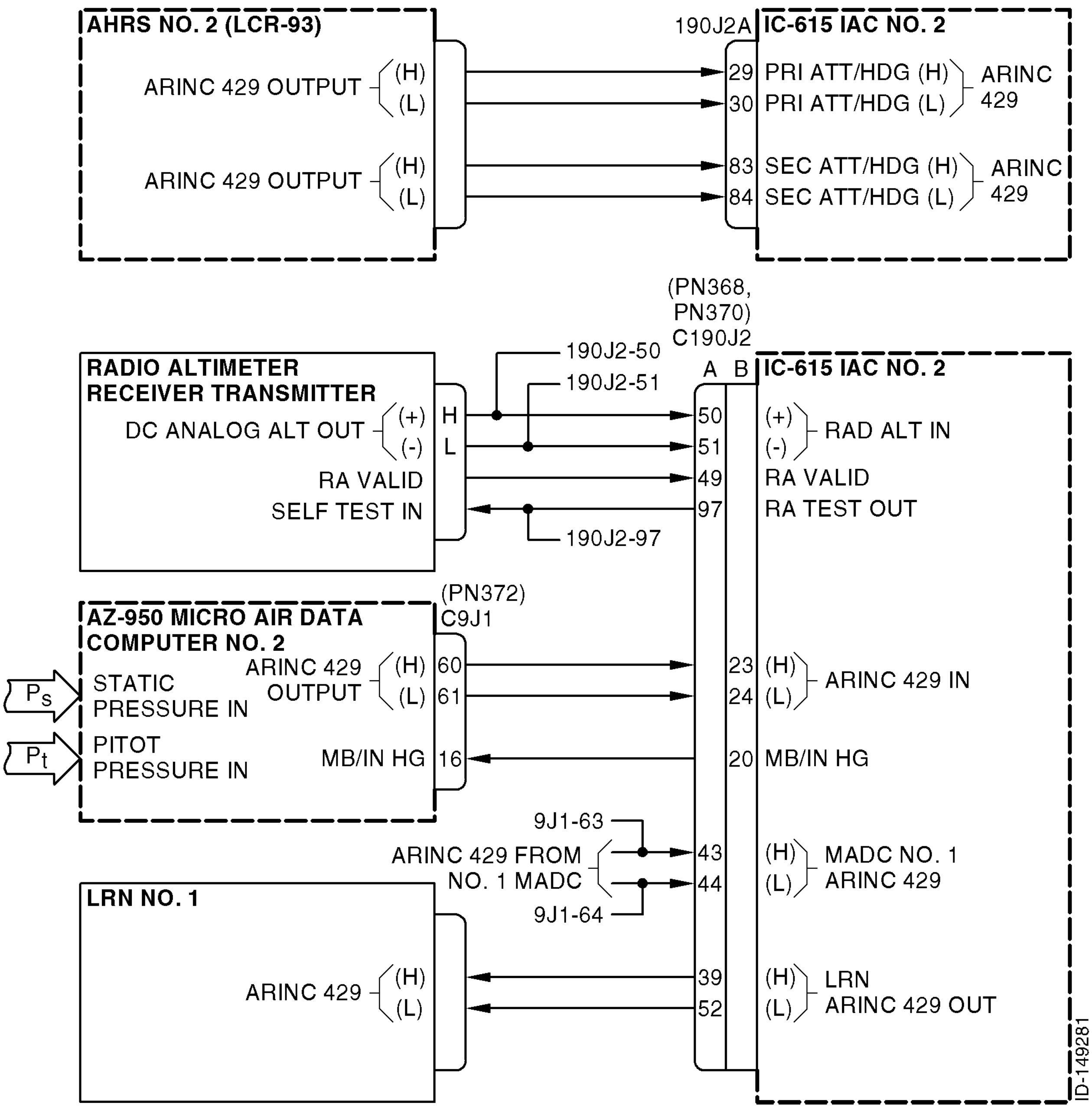

Figure 2-5-8 (Sheet 2). Flight Director Lateral Mode Interface - Copilot's Side

(3) Functional Operation

(a) The descriptions and figures in this section assume that the pilot's flight director is master.

(b) Heading Select Mode

1 The heading select mode is used to intercept and maintain a magnetic heading reference. The mode is engaged by pushing the HDG button on the pilot's MS-560 mode selector. The heading select mode is automatically engaged when the LOC, BC, VOR, LNAV, or VAPP modes are armed. HDG is annunciated on the master PFD and the vertical bar on the MS-560 mode selector HDG button lights. Engaging the heading select mode resets all previously selected active lateral modes.

2 The heading bug on each PFD is positioned around the compass card to the heading the pilot desires to intercept, using the HEADING knob on the RI-553 remote instrument controller. The heading select error signal, sent to the flight director processor, is the difference between actual aircraft heading and the selected aircraft heading. The flight director processor generates the proper roll command to intercept and maintain the pilot-selected heading. The heading select mode operating limits are given in Table 2-5-7.

Table 2-5-7. Heading Select Mode Operating Limits

Parameter	Value
Roll angle limit	± 27.5°
Low bank limit	± 14.0°
Roll rate limit	4.0°/sec

3 The heading select mode is canceled as follows:

- Any other lateral steering mode is captured.
- Another lateral controlling mode is selected.
- The go-around mode is selected.
- The SG reversionary mode is selected.
- The heading reversionary mode is selected.
- The HDG button is pushed on the MS-560 mode selector.
- The flight director couple function is changed.

(c) Heading Select Mode Engage/Disengage Logic

1 Heading Select Mode Engage Logic

a The heading select mode lets the flightcrew capture and track a manually selected heading. The mode can be engaged with the autopilot engaged or disengaged. The heading select mode is engaged when either the HDG button is pushed on the MS-560 mode selector, or automatically when the flightcrew arms the localizer, back course localizer, VOR, or VOR approach modes. The heading mode is engaged when all of the following conditions are met:

- The selected heading source is valid.
- The turn knob is in its detent if the autopilot is engaged.
- The heading select mode is not already engaged.
- The primary pitch attitude source is valid.
- The flight director status is master.
- The flight director is not reverted to the cross-side IAC.

2 Heading Select Mode Disengage Logic

a The heading select mode is automatically disengaged if any of the following conditions occur:

- The HDG button is pushed on the MS-560 mode selector.
- The armed localizer, localizer back course, VOR or VOR approach mode captures.
- The go-around mode is engaged.
- The FMS LNAV mode is selected and the resulting steering command is valid.
- The turn knob is moved out of its detent with the autopilot engaged.
- The selected heading source is changed.
- The selected heading source is invalid.
- The flight director status changes from master to slave.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

b If the flight director goes invalid, the command cue goes out of view. If the AHRS attitude data goes invalid, the mode clears, and an ATT failure flag is displayed on the master PFD. If the AHRS heading data goes invalid, the mode clears, and a HDG FAIL flag is displayed on the master PFD.

(d) VOR (NAV) Mode

1 The VOR mode provides for automatic intercept, capture, and tracking of a selected inbound or outbound VOR radial, using the selected VOR navigation source displayed on the master PFD. The flightcrew has the capability to tune an enroute VOR navigation source, select a desired course, and have the flight director issue guidance commands to either the pilot or the autopilot to automatically capture and track the selected enroute VOR. The navigation source displayed on the PFD is a function of the NAV source buttons located on the onside DC-550 display controller.

2 Prior to engaging the VOR mode, the pilot performs the following:

- Tunes the navigation receiver to the desired VOR frequency
- Selects NAV as the navigation source on the onside DC-550 display controller
- Sets the course pointer for the master PFD for the desired course to be flown
- Sets heading bug on the PFD to the desired intercept heading for the selected course.

3 With the aircraft outside the normal capture range of the VOR signal (typically the course deviation on the PFD is greater than two dots), the pilot pushes the NAV button on the master side MS-560 mode selector. The HDG and NAV buttons on the MS-560 mode selector light. HDG in green and VOR in white are also annunciated on the PFD. The flight director sees the target VOR radial as a lateral angular deviation and a course error between the current aircraft heading and the selected VOR course. The flight director is armed to capture the VOR signal and is generating a roll command to fly the heading select mode (see Figure 2-5-9 and Figure 2-5-10).

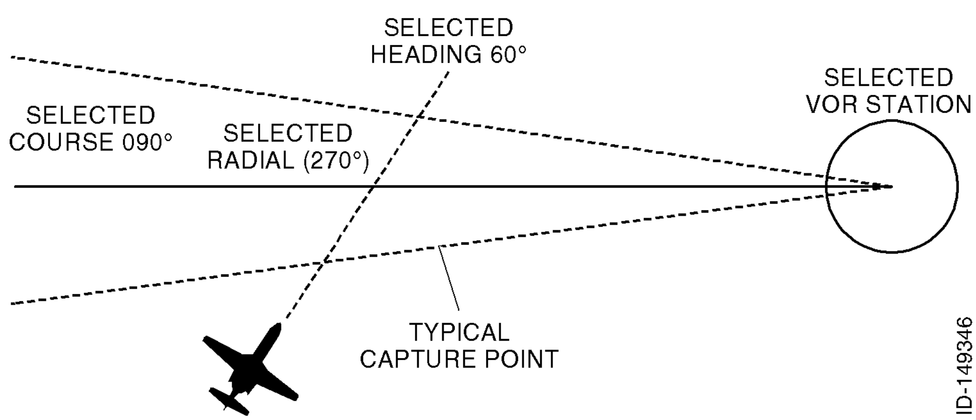

Figure 2-5-9. VOR Arm Pictorial

Figure 2-5-10. VOR (NAV) Mode Armed

4 When reaching the LBS trip point, the flight director automatically drops the heading select mode and switches to the VOR capture phase (see Figure 2-5-11 and Figure 2-5-12). The following is observed on the PFD:

- The white VOR annunciator turns off
- The green HDG annunciator turns off
- A green VOR is annunciated and is enclosed in a white box for 5 seconds to emphasize the capture phase of operation.

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5 The IC-615 IAC generates the proper roll command to bank the aircraft to capture and track the selected VOR radial.

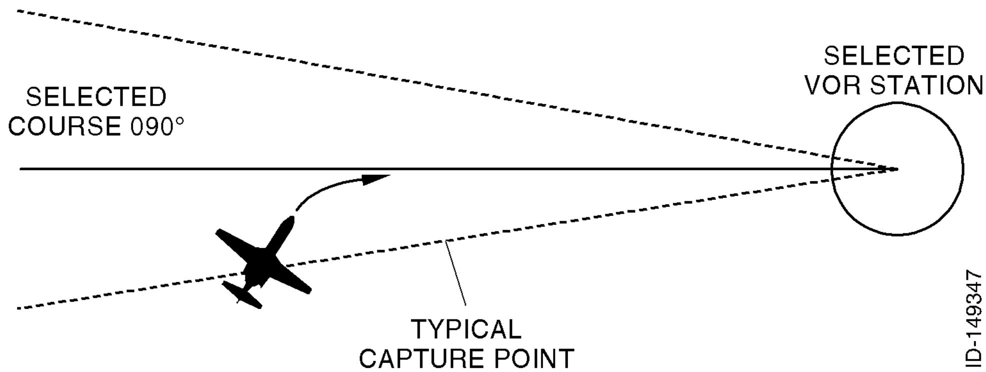

Figure 2-5-11. VOR Capture Pictorial

6 When the course select pointer was set on the master PFD (using the appropriate course knob on the RI-553 remote instrument controller), the course select error signal was established. This signal represents the difference between actual aircraft heading and the desired aircraft course.

7 The radio signal is routed from the navigation receiver to the IC-615 IAC, where the radio signal is processed and lateral gain programmed.

8 Lateral gain programming is performed as a function of DME distance to the station (if available) and TAS. Gain programming adjusts for the aircraft flying either toward or away from the VOR station. If DME data is not valid or available, an estimated value is used. Prior to VOR capture, the DME estimated value is 25 miles. After capture, the DME estimated value is 10 miles.

NOTE: Operating in DME hold during VOR capture and tracking operation should be avoided, if possible. When in DME hold, the flight director processor cannot use DME distance for gain programming.

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Figure 2-5-12. VOR (NAV) Mode Capture

9 When flying a VOR intercept, the optimum intercept angle should be 45 degrees or less. If the intercept angle is greater than 45 degrees, course cut limiting can occur.

10 The course cut limiter functions primarily when approaching the selected VOR radial at an intercept angle greater than 45 degrees and at a high rate of speed. Its function is to limit steering commands to 45 degrees, which forces a flightpath to get on the selected radial sooner to prevent overshooting the VOR beam center. Typically, the roll command makes an initial heading change, levels out and flies toward the beam, then makes a second heading change to get lined up on the center of the selected radial (see Figure 2-5-13).

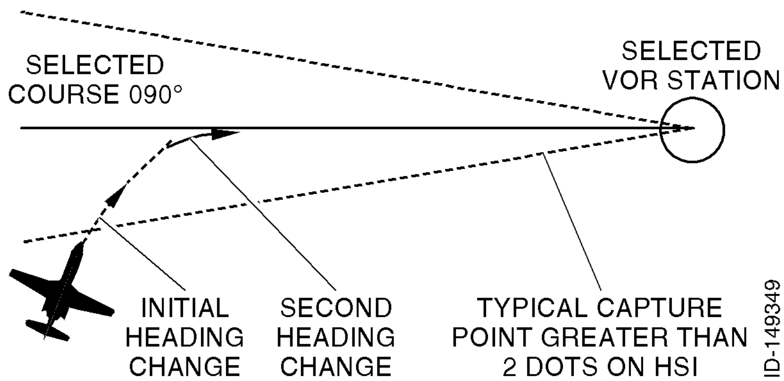

Figure 2-5-13. VOR Course Cut Limiting

Figure 2-5-14. VOR Track

11 When the aircraft satisfies VOR track conditions, the course error signal is removed from the lateral steering command. This leaves radio deviation and DME gain programming (if available) to track the VOR signal and compensate for beam standoff in the presence of a crosswind. The flight director automatically compensates for a crosswind of up to 45 degrees course error (see Figure 2-5-14).

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12 As the aircraft approaches the VOR station, it enters a zone of unstable radio signal. This zone of confusion radiates upward from the station in the shape of a truncated cone. In this area, the radio signal becomes highly erratic and it is desirable to remove it from the roll command. The OSS monitors entry into the zone of confusion and removes radio deviation from the roll command. The system also uses the co-located DME signal (if available) to adjust tracking gains.

13 When over the VOR station or after VOR station (Figure 2-5-15), the flight director accepts and follows course changes, up to 90 degrees.

14 The navigation (VOR) mode is disengaged if any of the following conditions occur:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

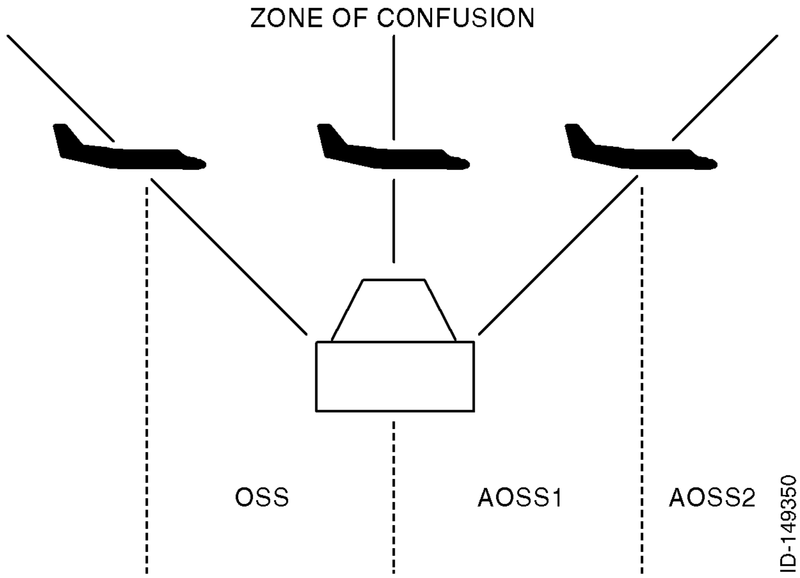

Figure 2-5-15. VOR Over Station

(e) VOR Approach Mode

1 The VOR approach mode is set up and flown in a manner similar to enroute VOR. However, instead of selecting the mode with the NAV button on the MS-560 mode selector, the APR button is pushed. The APR button lights and VAPP is displayed in white on the master PFD. The flight director applies the gains appropriate for an approach. Upon capture of the selected course, the master PFD displays VAPP in green. Table 2-5-8 gives the mode operating limits.

Table 2-5-8. VOR/VOR Approach Mode Operating Limits

Mode	Parameter	Value
VOR or VOR APR	**Capture**	
	• Beam intercept angle (HDG SEL)	Up to ±90°
	• Capture point	Function of beam, beam rate, course error, DME distance. Maximum trip point is 13.3°. Minimum trip point is 1°
	• Roll angle limit	±27.5°
	• Roll rate limit	4.0°/sec
	• Course cut limit at capture	±45° during capture
	On Course	
	• Roll angle limit	±13°
	• Roll rate limit	1.0°/sec
	• Crosswind correction	Up to ±45° course error in VOR Up to ±30° in VOR APR
	Over Station	
	• Course change	Up to ±90°
	• Roll angle limit	±13° of roll
	• Roll rate limit	4°/sec

(f) VOR/VAPP Mode Engage/Disengage Logic

1 VOR Arm Engage Logic

a The VOR mode is engaged in the arm phase when the flightcrew pushes the NAV button on the MS-560 mode selector and the following conditions are met:

- The flight director is not already in the VOR mode.
- The selected VOR source is received.
- The selected heading source is valid.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- If the autopilot is engaged, the turn knob is in its detent.
- Heading mode select is not already engaged.
- Flight director status is master.
- Flight director is not reverted to the cross-side IAC.

2 VOR Arm Disengage Logic

a VOR arm is automatically disengaged if any of the following conditions occur:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

3 VOR Capture Engage Logic

a The VOR capture phase engages if the VOR caption criteria is met and the following conditions occur:

- The selected navigation source is received.
- The selected heading source is valid.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The turn knob is in its detent if the autopilot is engaged.
- The flight director status is master.
- The flight director is not reverted to the cross-side IAC.

4 VOR Capture Disengage Logic

a VOR capture automatically disengages if any of the following conditions occur:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

5 VOR Track Logic

a VOR track occurs when VOR has been captured for at least 300 seconds, or if the following conditions occur:

- The LBS has tripped.
- The course error is less than 22 degrees.
- The bank angle is less than 6 degrees.
- The beam deviation is less than 5 degrees.

6 VOR OSS Engage Logic

a The VOR OSS engages when the VOR over station criteria is met as follows:

- The selected VOR phase is arm, capture, or track.
- The selected heading source is valid.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The turn knob is in its detent if the autopilot is engaged.
- The flight director status is master.
- The flight director is not reverted to the cross-side IAC.

b The flight director considers the aircraft to be within the maximum lateral beam deviation if the aircraft position is such that the magnitude of its lateral beam deviation is less than 13.3 degrees. Otherwise, the aircraft is considered to be outside the maximum lateral beam deviation. While in the VOR OSS phase, the condition is considered not satisfied when the following criteria is met:

- The flight director no longer considers the aircraft to be in the zone of confusion.
- The VOR beam deviation rate criteria has not been violated within the last 20 continuous seconds.
- The navigation source overfly criteria has not been met within the last 20 continuous seconds.

7 VOR OSS Disengage Logic

a The following conditions disengage VOR OSS mode:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(g) Localizer (NAV), Localizer Approach, and Back Course Modes

1 The localizer mode is the lateral portion of an automatic ILS approach. This mode operates independently in a navigation state or in conjunction with the glideslope mode in an approach state. The localizer mode allows the flightcrew to tune an ILS navigation source, select the applicable runway course, and allow the flight director to issue commands to the pilot or the autopilot to capture and track the ILS localizer beam to the desired runway centerline. The target used by the localizer mode is the selected course radial associated with the displayed ILS navigation source. The selected course normally corresponds to the runway heading. The flight director does not guide directly to the target, but sees it in terms of lateral deviation from the selected radial and a course error between the current aircraft heading and the selected localizer course. Prior to mode engagement, the pilot performs the following:

- Tunes the onside navigation receiver to the published front course localizer frequency for the runway in use
- Pushes the NAV button on the onside DC-550 display controller to select LOC as the navigation source
- Sets the course pointer on the master side PFD for the inbound runway heading
- Sets the heading bug for the desired heading to perform the course intercept.

2 The PFD displays the relative position of the aircraft to the center of the localizer beam and the selected inbound course, as shown in Figure 2-5-16. With the heading bug set for course intercept, the heading select mode is automatically used to perform the intercept. Outside the normal capture range of the localizer signal, pushing the NAV button on the master MS-560 mode selector causes the master PFD to annunciate HDG in green and LOC in white, as shown in Figure 2-5-17.

3 The aircraft is now flying the selected heading intercept, and the flight director is armed for automatic localizer beam capture.

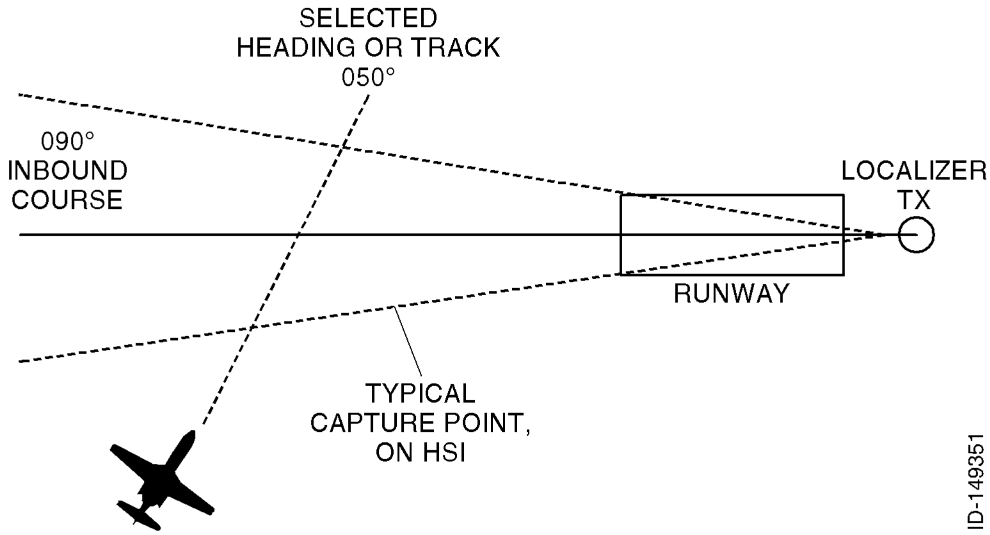

Figure 2-5-16. Localizer Arm Pictorial

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Figure 2-5-17. Localizer (NAV) Mode Arm

4 With the aircraft approaching the selected course intercept, as shown in Figure 2-5-18, the LBS is monitoring localizer beam deviation, beam rate, and TAS. At the computed time, the LBS trips and captures the localizer signal. The flight director drops the heading select mode and generates the proper roll command to bank the aircraft toward localizer beam center. When the LBS trips, the following is observed on the PFD, as shown in Figure 2-5-19:

- The green HDG annunciation turns off.
- The white LOC annunciation turns off.
- The green LOC annunciation comes on and is enclosed in a white box for 5 seconds to emphasize the capture phase of operation.

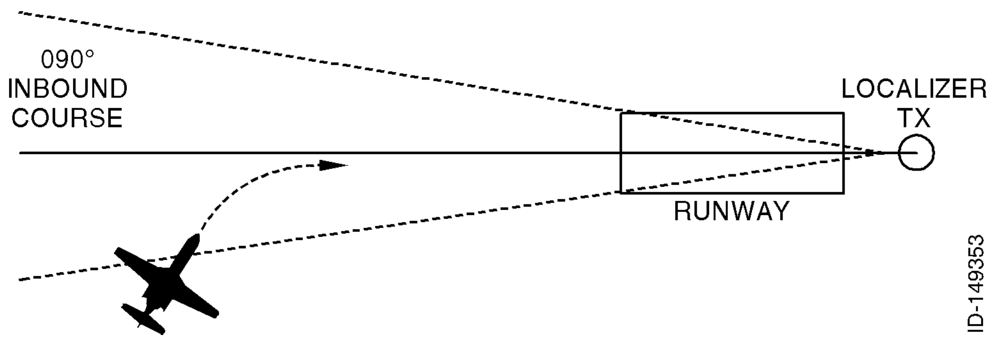

Figure 2-5-18. Localizer Capture Pictorial

Figure 2-5-19. Localizer Capture

5 The flight director processor generates the proper roll command to bank the aircraft to capture and track the selected localizer signal.

NOTE: When flying a localizer intercept, the optimum intercept angle is 45 degrees or less. If the intercept angle is greater than 45 degrees, course cut limiting can occur as previously described in the VOR mode of operation.

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6 When the course select pointer was set on the master-side PFD using the appropriate course knob on the RI-553 remote instrument controller, the course select error signal was established. This signal represents the difference between actual aircraft heading and selected aircraft course.

7 Lateral gain programming is required to adjust the gain applied to the localizer signal, due to the aircraft approaching the localizer antenna and beam convergence caused by the directional properties of the localizer antenna. The lateral gain programmer is controlled by the change in radio altitude when the aircraft is below 2,400 ft radio altitude and the radio altimeter is valid. If the radio altimeter is not valid, gain programming occurs as a function of localizer beam capture.

8 The localizer mode is canceled by the following:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

9 When the aircraft meets the localizer capture conditions, the course error signal is removed from the lateral calculations. This leaves localizer gain programming to track the localizer signal, as shown in Figure 2-5-20, and to compensate for localizer beam standoff in the presence of a crosswind. The system automatically compensates for a crosswind of up to 45 degrees course error. Figure 2-5-21 shows the PFD in the localizer tracking mode.

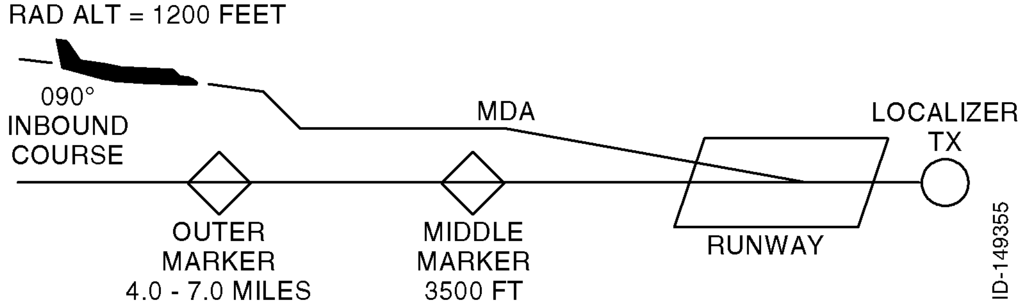

Figure 2-5-20. Localizer Track Profile View

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Figure 2-5-21. Localizer Track

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10 The back course mode automatically intercepts, captures, and tracks the back course localizer signal, as shown in Figure 2-5-22. When flying a back course localizer approach, glideslope capture is automatically inhibited. The back course localizer approach is set up and flown identically to a front course localizer approach, with the following differences:

- The heading bug is set for the back course intercept.
- The BC button is pushed on the master MS-560 mode selector. Pushing the BC button on the master MS-560 tells the flight director processor to reverse the course and radio inputs 180 degrees.

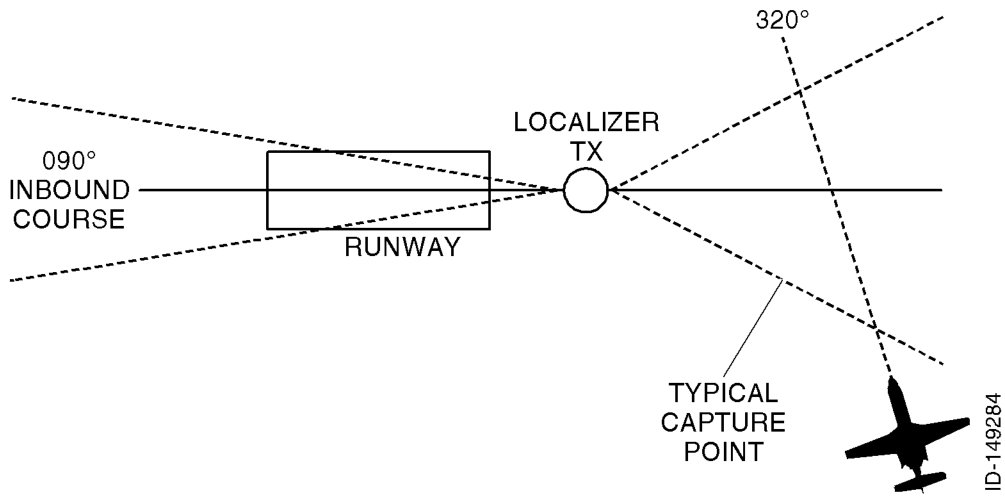

Figure 2-5-22. Back Course Mode Pictorial

11 With the aircraft outside the normal back course localizer capture limits, the PFD annunciates BC in white and HDG in green, as shown in Figure 2-5-23.

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Figure 2-5-23. Back Course Arm

12 At back course capture, the PFD annunciates BC in green, as shown in Figure 2-5-24. The BC annunciation is enclosed in a white box for 5 seconds.

Figure 2-5-24. Back Course Capture

13 At back course capture, the flight director generates a roll command to capture and track the back course signal, as shown in Figure 2-5-25.

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Figure 2-5-25. Back Course Track

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14 The back course mode is cancelled by any one of the following:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

15 The back course approach mode is set up and flown similarly to the front course localizer mode, with the following differences:

- On the MS-560 mode selector, the BC button is pushed instead of the NAV button.
- On the PFD, the following annunciators light:
  - HDG in green
  - BC in white.

16 Refer to Table 2-5-9 for localizer and back course mode operating limits.

Table 2-5-9. Localizer and Back Course Mode Operating Limits

Mode	Parameter	Value
LOC/BC	**LOC or BC Capture**	
	Beam intercept angle	Up to ±90°
	Capture point	Function of beam, beam rate, and course error Min trip point: 0.75° Max trip point: ±2.6°
	Roll angle limit	±27.5°
	Roll rate limit	5.0°/sec
	Course cut limit	30° during capture
	NAV On-Course	

Table 2-5-9. Localizer and Back Course Mode Operating Limits (cont)

Mode	Parameter	Value
	Roll angle limit	$\pm 13°$ roll
	Roll rate limit	1°/sec
	Crosswind correction	$\pm 30°$ of course error
	Gain programming	Starts at 1200 ft radio altitude. Gain reduction = 1 to 0.5

(h) LOC/BC Mode Engage/Disengage Logic

1 LOC/BC Arm Engage Logic

a The localizer/back course arm phase engages when the flightcrew pushes the NAV or APR button on the MS-560 mode selector and the following conditions are met:

- The flight director is not already in the localizer mode (any phase).
- The selected navigation source is an ILS.
- The selected heading source is valid.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The turn knob is in its detent if the autopilot is engaged.
- The flight director status is master.
- The flight director is not reverted to the cross-side IAC.

b If the localizer arm phase is successfully engaged via the NAV button on the MS-560 mode selector, the localizer mode is considered to be in a navigation state. If the localizer arm phase is successfully engaged via the APR button on the MS-560 mode selector, the localizer mode is considered to be in an approach state. If the localizer arm phase is active in the navigation state, pushing the APR button on the MS-560 mode selector causes the localizer mode to transition to the approach state.

2 LOC/BC Arm Disengage Logic

a The localizer/back course arm phase automatically disengages if any of the following conditions occur:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

3 LOC/BC Capture Engage Logic

a The flight director attempts to time the localizer capture so that the aircraft executes a tangential flare intercept to the selected localizer radial. In the case where the intercept angle is shallow, the flight director forces capture of the localizer beam based upon a minimum beam deviation criteria. The capture engage logic is satisfied when the following conditions occur:

- The selected navigation source is an ILS.
- The selected heading source is valid.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The turn knob is in its detent if the autopilot is engaged.
- The flight director status is master.
- The flight director is not reverted to the cross-side IAC.

b If the localizer capture phase is currently in the navigation state. pushing the APR button on the MS-560 mode selector causes the localizer mode to transition to the approach state. If the localizer capture phase is currently in the approach state. pushing the APR button on the MS-560 mode selector causes the localizer mode to transition to the navigation state.

4 LOC/BC Capture Disengage Logic

a LOC/BC capture automatically disengages if any of the following conditions occur:

- The NAV, APR, or HDG buttons on the MS-560 mode selector are pushed.
- The go-around mode is selected.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(i) Long Range Navigation

1 The FMS LNAV mode provides an interface between the FMS computed guidance commands and the flight director display and automatic guidance. In this mode, the flight director does not provide any targeting, capture, or tracking control. Depending upon the installed FMS, the system can perform automatic arm and capture of the FMS supplied track, and immediate capture of the FMS supplied track (see Figure 2-5-26). Common LNAV characteristics are as follows:

- Instead of using course error and radio deviation, a composite lateral steering command is used from the long range navigation computer by the IC-615 IAC symbol generator function.
- The symbol generator function supplies the flight director with the required steering commands.
- The lateral steering command is lateral gain programmed in the long range computer and is not gain programmed again in the IAC. The steering command is limited to ±32 degrees of bank in the IAC (refer to Table 2-5-10).

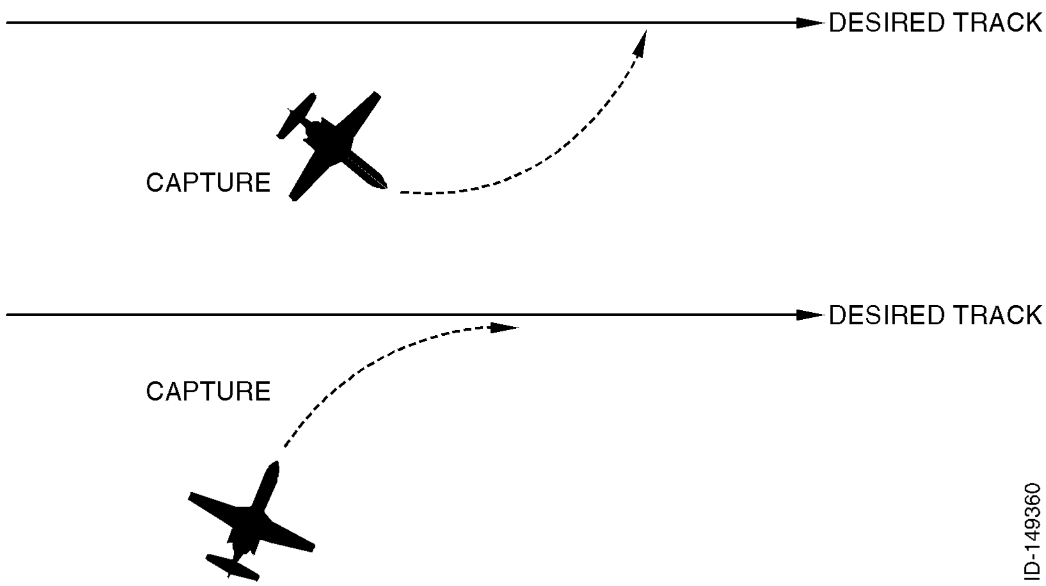

Figure 2-5-26. LNAV Capture and Tracking Pictorial

Table 2-5-10. LNAV Mode Operating Limits

Parameter	Value
Roll angle limit	±32°
Roll rate limit	5.0°/sec

2 Automatic LNAV Arm/Capture

a Pushing the NAV button on the master MS-560 mode selector causes the heading mode to annunciate ON and LNAV is armed. At the proper point, the flight director captures the FMS supplied track and LNAV is annunciated in green on the master PFD (see Figure 2-5-27).

3 Immediate LNAV Capture

a Pushing the NAV button on the master MS-560 mode selector causes the flight director LNAV mode to annunciate in green on the master PFD. The flight director function immediately captures the desired track.

Figure 2-5-27. LNAV Tracking

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b The LNAV mode is canceled by any one of the following:

- The NAV or HDG buttons on the master MS-560 mode selector are pushed.
- The go-around mode is selected.
- The LNAV steering command goes invalid.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(j) LNAV Mode Engage/Disengage Logic

1 LNAV Mode Engage Logic

a The LNAV mode engages when the following conditions occur:

- The flight director is not already in LNAV mode.
- The selected navigation source is an FMS.
- A valid LNAV steering command exists.
- The selected heading source is valid.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The turn knob is in its detent if the autopilot is engaged.
- The flight director status is master.
- The flight director is not reverted to the cross-side IAC.

2 LNAV Capture Disengage Logic

a The LNAV mode automatically disengages if any of the following conditions occur:

- The NAV or HDG buttons on the master MS-560 mode selector are pushed.
- The go-around mode is selected.
- The LNAV steering command goes invalid.
- The selected navigation source is changed.
- The selected heading source is changed.
- The selected heading source is invalid.
- The turn knob is out of its detent and the autopilot is engaged.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

C. Flight Director Vertical (Pitch) Channel Functional Operation

(1) Figure 2-5-28 shows LRU interface for pilot's side flight director vertical modes. Figure 2-5-29 shows LRU interface for copilot's side flight director vertical modes.

(2) LRU Vertical Functions

(a) The function of each LRU for each vertical mode is discussed in the paragraphs that follow.

(b) AZ-950 MADC

1 The onside AZ-950 MADC supplies the onside IC-615 IAC with an ARINC 429 input of air data values, including TAS. The TAS signal is used in some vertical flight director modes for gain programming. The response of the aircraft should feel the same to the pilot regardless of the aircraft's airspeed and altitude. Since it requires less flight control surface deflection at high speed and high altitude to complete a maneuver than it does at low speed and low altitude, changing the size of the signal as a function of TAS achieves the desired results.

2 If the AZ-950 MADC becomes invalid, a fixed bias TAS of 120 knots is used in the IC-615 IAC. The default value of TAS is set for the approach speed region of flight.

3 Additionally, the AZ-950 MADC supplies the onside flight director with the following vertical mode references:

- Barometric altitude
- Indicated airspeed/Mach
- Altitude rate (vertical speed).

(c) MS-560 Mode Selector

1 The MS-560 mode selector lets the pilot engage/disengage all vertical flight director modes, with the exception of altitude preselect and go-around. Each MS-560 mode selector transmits button data as two-wire greycode formatted data to its onside DC-550 display controller. The DC-550 display controller transmits the button data to its onside IC-615 IAC over a dedicated DC-IC bus. The MS-560 receives a ground input from its onside IC-615 IAC to light the mode button for an armed or captured condition.

(d) DC-550 Display Controller

1 The DC-550 display controller supplies an RS-422 digital bus interface (DC-IC bus) between itself and its onside IC-615 IAC to transmit MS-560 button mode selection data.

(e) Radio Altimeter

1 The radio altimeter supplies an analog output of absolute altitude above the terrain. This signal is used by the flight director to gain program the glideslope signal. Gain programming is required, due to the directional qualities and beam convergence characteristics of the glideslope antenna.

2 As the aircraft approaches the runway, the glideslope signal appears to get stronger and the beam appears to get narrower. By reducing the gain on the signal as a function of the change in radio altitude, the computed steering command does not take the aircraft out of the glideslope beam envelope.

3 If the radio altimeter is invalid, gain programming starts as a function of glideslope capture and runs down as a function of TAS and time. At the middle marker, gain programming is synchronized to a preset value.

(f) Navigation Receiver

1 The navigation receiver supplies an ARINC 429 output of glideslope deviation data, as well as marker beacon data.

(g) LRN Unit (Not supplied by Honeywell)

1 The LRN unit supplies an ARINC 429 composite steering command output to the IC-615 IAC. Gain programming for the composite steering command is done in the LRN unit.

(h) IC-615 IAC

1 The IC-615 IAC performs the following, as a function of whichever vertical mode is active.

2 Pitch Attitude Hold

a When only a lateral flight director mode is active, the IC-615 IAC memorizes the pitch attitude of the aircraft at the time the lateral mode was selected. This becomes the pitch attitude reference displayed on the master side PFD. There is no annunciation for the pitch attitude hold mode.

b Pitch attitude is changed by pushing and holding the TCS button and maneuvering the aircraft to a new position. Releasing the TCS button causes the IC-615 IAC to memorize the new attitude reference.

3 Vertical Speed Hold

a The IC-615 IAC receives vertical speed information from the onside AZ-950 MADC. This vertical speed information becomes the reference vertical speed in the master IC-615 IAC when the mode is engaged.

b The vertical speed reference is changed as a function of moving the PITCH wheel on the PC-400 autopilot controller or by pushing and holding the TCS button while flying the aircraft manually to a new vertical speed reference. When the vertical speed mode is engaged, the speed set bug is displayed on the vertical speed scale, and the vertical speed air data command reference is displayed above the vertical speed scale on the PFD.

c Fight Director Only – When the vertical speed mode is engaged and the autopilot is off, vertical speed steering commands are presented to the pilot on the master PFD command bar. By flying the miniature aircraft symbol to the flight director command bar, the pilot satisfies the flight director command.

d Autopilot Engaged - With the autopilot and the vertical speed mode engaged, vertical speed steering commands are sent to the autopilot for automatic flightpath steering.

4 Altitude Preselect Mode

a The IC-615 IAC receives inputs of uncorrected pressure altitude, baro corrected pressure altitude, and pilot selected altitude. The flight director processor combines the pressure altitude inputs through complimentary filtering to obtain more precise barometric altitude data.

b In the IC-615 IAC, the difference between actual aircraft altitude and selected aircraft altitude (ASEL) is defined as the altitude error signal.

c The altitude error signal is converted into a computed vertical speed signal. If the aircraft's actual vertical speed is less than the computed vertical speed, ASEL remains armed. When the aircraft's actual vertical speed is greater than the computed vertical speed, the flight director processor captures the selected altitude and commands the flare maneuver.

d There is no button to select the ASEL mode on the MS-560 mode selector. Altitude preselect automatically arms when the following conditions exist simultaneously:

- The altitude error is decreasing.
- The computed vertical speed is greater than the actual vertical speed.
- The autopilot is not in the altitude hold mode.
- The glideslope is not in the capture or track mode.
- The vertical speed is greater than 100 ft/min for 3 seconds.
- The target altitude is at least 250 ft from present altitude.

e Flight Director Only - With the ASEL mode armed, the master PFD presents a vertical steering command of whichever other vertical mode is in use. When ASEL transitions from arm to capture, a vertical steering command is presented to the pilot to flare the aircraft onto the selected altitude.

f Autopilot Engaged - With the autopilot engaged and the ASEL mode captured, steering commands are sent to the autopilot for automatic altitude capture.

5 Altitude Hold Mode

a The IC-615 IAC receives an input of baro corrected pressure altitude from the onside AZ-950 MADC. The flight director processor compares actual aircraft altitude against the altitude hold reference to generate the altitude hold error signal.

b Flight Director Only - With the ALT hold mode engaged, the master PFD presents a vertical steering command to the pilot to fly the aircraft back to the reference altitude.

c Autopilot Engaged - With the autopilot and the ALT hold mode engaged, the vertical steering command is sent to the autopilot for automatic flightpath steering.

6 ILS Approach Mode

a When the ILS APR mode is armed, the flight director processor looks at TAS, vertical speed, and glideslope deviation to determine when to capture the glideslope. This is accomplished by the VBS. When the glideslope is captured, the flight director processor automatically drops whichever other vertical mode was engaged and starts tracking the glideslope signal. If the localizer signal is lost for any reason, the APR mode is also dropped.

b With the autopilot not engaged, the glideslope error signal is presented on the master PFD command bar as a computed steering command for the pilot to raise or lower the aircraft nose and fly back to glideslope beam center.

c With the aircraft tracking the glideslope beam, the following conditions exist:

- The radio deviation is zero.
- The command cue is centered.
- The control wheel is centered.
- The aircraft is tracking the glideslope beam.

d With the autopilot engaged, the flight director processor generates the commands stated above and sends them to the autopilot for automatic flightpath steering. On the master PFD, the command bar can move a little out of center and then return. With the autopilot satisfying the flight director steering command, the command bar is centered.

7 VNAV Mode

a The VNAV mode gives a means to define and track a climb or descent path to a vertical waypoint ahead of the aircraft. The waypoint is defined based on a distance reference TO or FROM a VOR station or an LRN waypoint. At the proper time, the flight director switches from VNAV to ASEL capture to ALT hold at the waypoint altitude.

8 Go-Around Mode

a The go-around mode is normally used to transition from an approach to land to a climbout condition in the event of a missed approach. The pilot selects go-around mode by pushing the GA button located on the throttle handle. With the go-around mode selected, all flight director modes are canceled.

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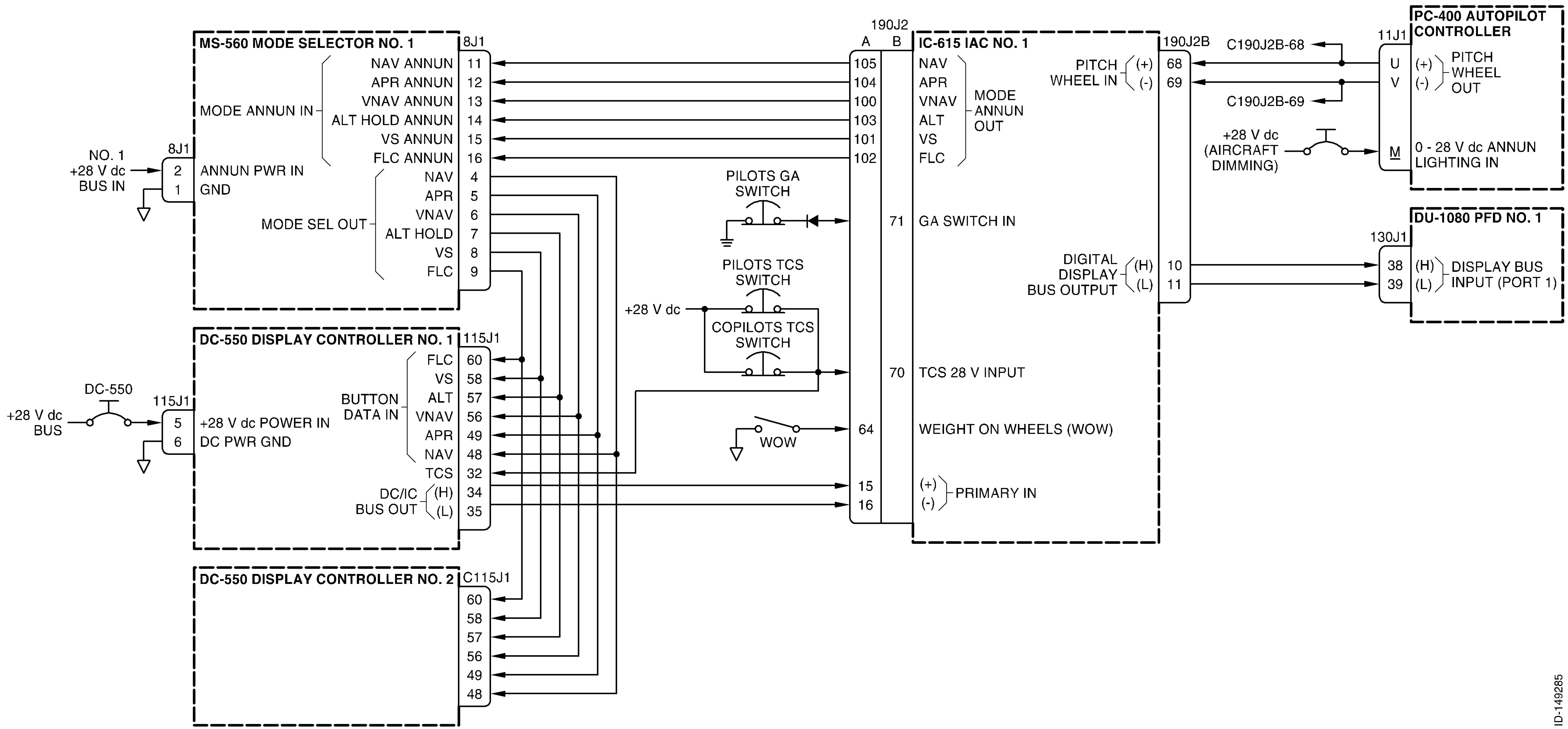

Figure 2-5-28 (Sheet 1). Flight Director Vertical Mode Interface - Pilot's Side

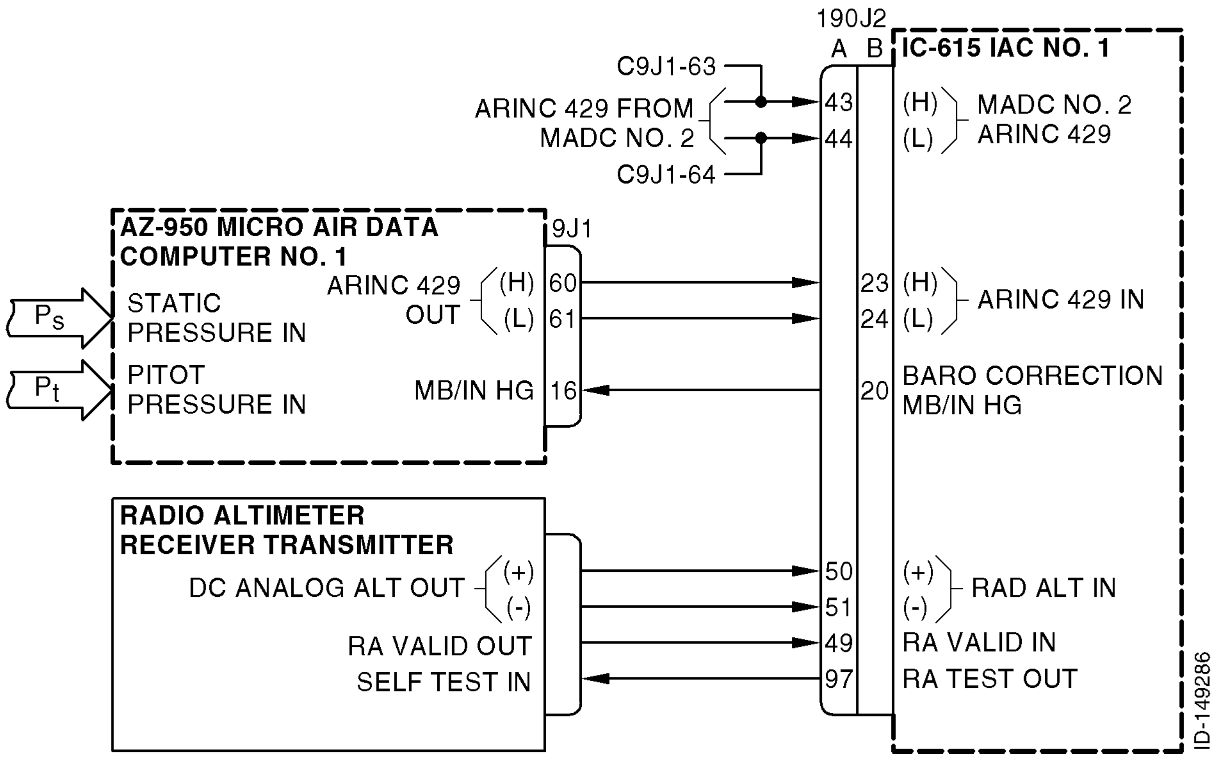

Figure 2-5-28 (Sheet 2). Flight Director Vertical Mode Interface - Pilot's Side

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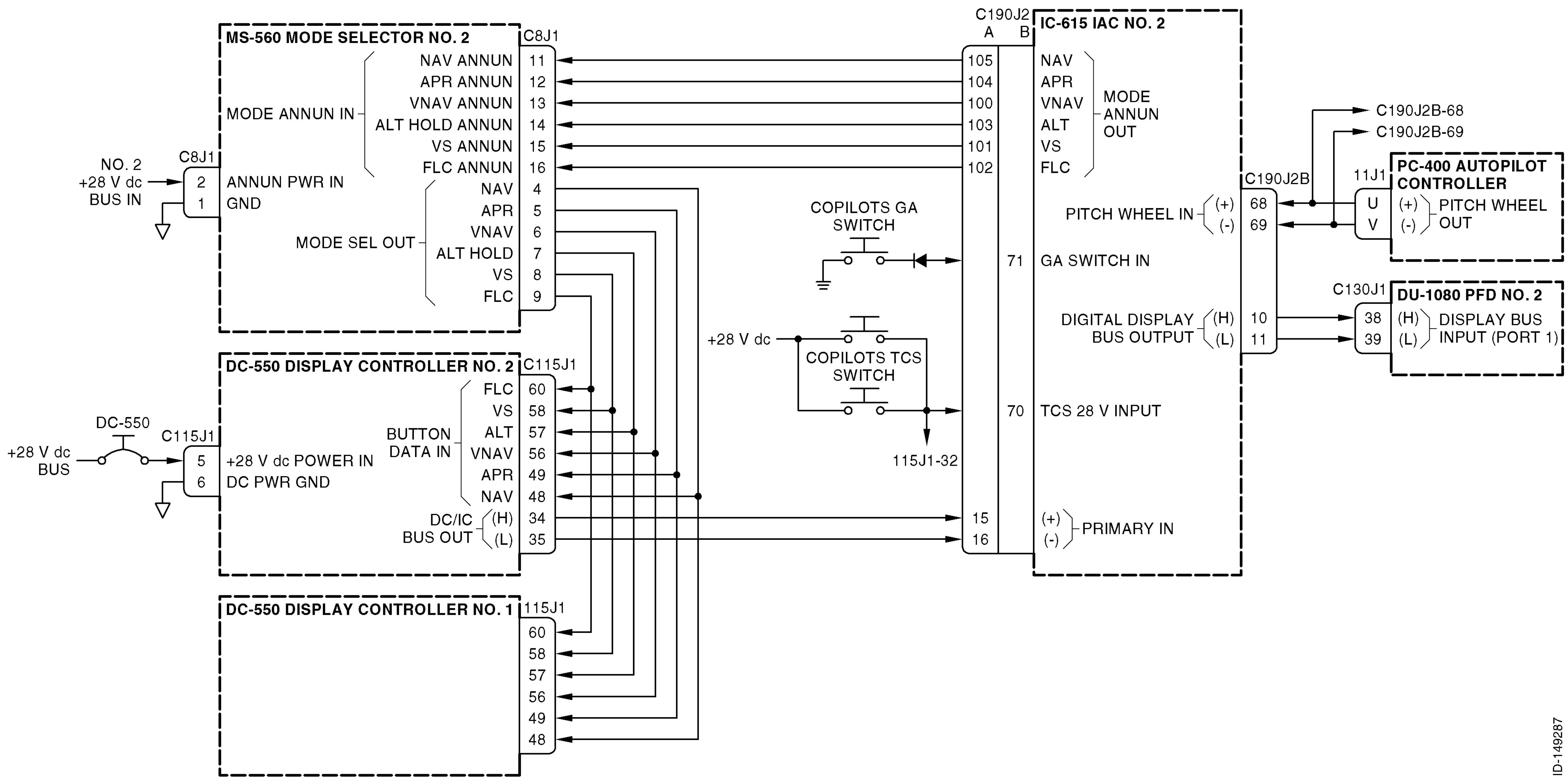

Figure 2-5-29 (Sheet 1). Flight Director Vertical Mode Interface - Copilot's Side

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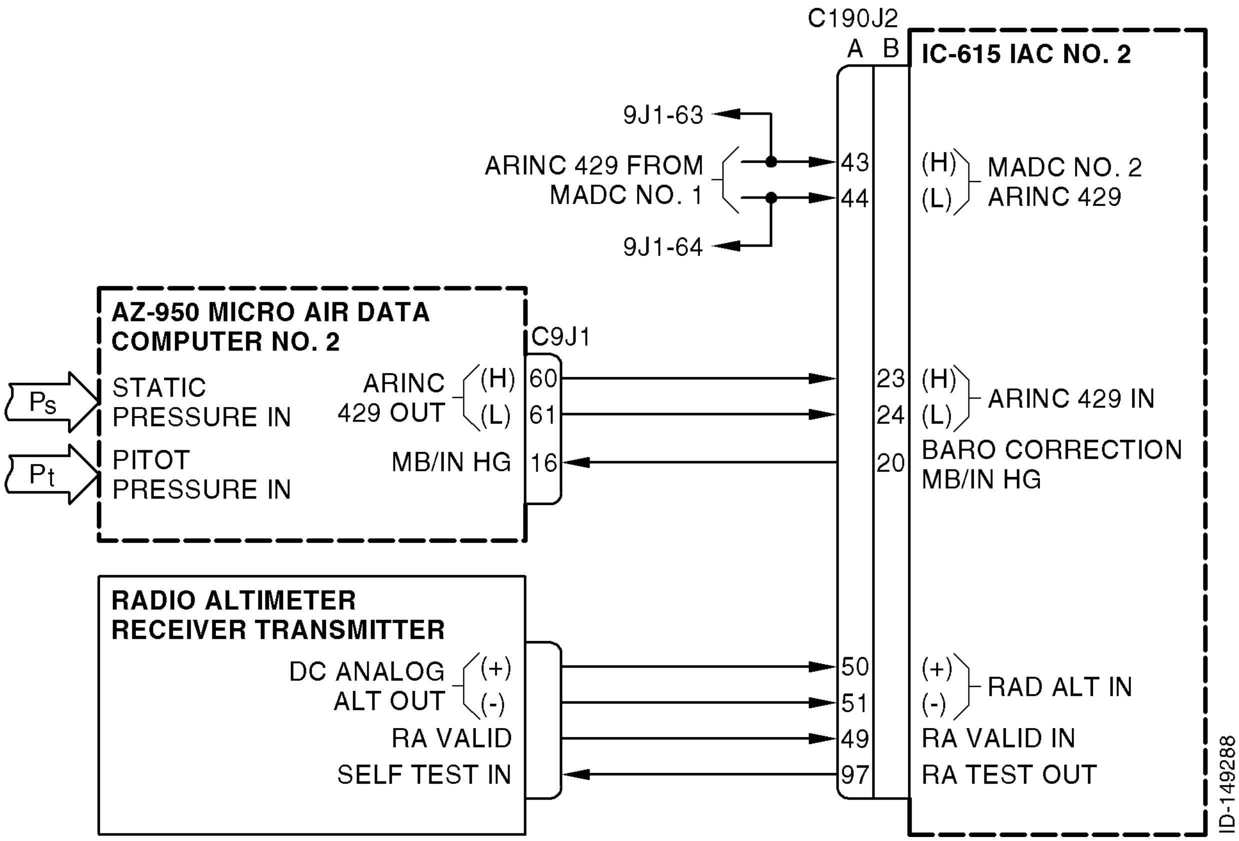

Figure 2-5-29 (Sheet 2). Flight Director Vertical Mode Interface - Copilot's Side

(3) Functional Operation

(a) The description and figures in this section assume the pilot's flight director is master.

(b) Pitch Attitude Hold Mode

1 Pitch attitude hold is the basic vertical flight director mode. It is activated when a flight director lateral (roll) mode is selected without an accompanying vertical (pitch) mode. There is no annunciation on the master PFD for the pitch hold mode. The pitch command on the master PFD gives the pilot a reference corresponding to the pitch attitude existing at the moment the lateral flight director mode was selected. The pitch reference may be changed with the TCS button located on the pilot's and copilot's control wheel or by using the PITCH wheel on the PC-400 autopilot controller, with the autopilot engaged.

2 Pitch attitude hold is canceled by selecting any vertical flight director mode or automatic capture of a vertical mode. The pitch attitude hold operating limits are given in Table 2-5-11.

Table 2-5-11. Pitch Attitude Hold Operating Limits

Mode	Parameter	Value
Pitch hold	Limit after engagement	±20°
	TCS	±20°
	Pitch wheel	±20°

(c) Pitch Attitude Hold Mode Engage/Disengage Logic

1 Pitch Attitude Hold Mode Engage Logic

a The pitch attitude hold mode is engaged when:

- No vertical modes are active
- The standby mode is not active, meaning that flight director vertical and lateral modes and the autopilot have been engaged.

2 Pitch Attitude Hold Mode Disengage Logic

a The pitch attitude hold mode is automatically disengaged if the conditions identified in paragraph (c)1 are no longer valid.

(d) Vertical Speed Hold Mode

1 The vertical speed hold mode (Figure 2-5-30 and Table 2-5-12) lets the flightcrew acquire and maintain a desired vertical speed target. The desired vertical speed may be chosen via the PITCH wheel on the autopilot controller, by engaging the autopilot, by selecting the vertical speed hold button on the MS-560 mode selector, or by using TCS to fly to the desired altitude and releasing. Overspeed protection based on the Vmo/Mmo speed limit is supplied as a submode of vertical speed hold. The vertical speed mode can be set to control either a positive rate (ascending) or a negative rate (descending). While the vertical speed mode is active, Vmo/Mmo overspeed protection is applied.

2 To initiate the mode, the pilot would maneuver the aircraft to the desired climb or descent attitude, establish the vertical speed reference, and engage the mode. When the vertical speed mode is engaged, the following occurs:

- The VS button on the MS-560 mode selector lights.
- VS in green is annunciated on the master PFD.
- The vertical speed target is displayed above the vertical speed scale on the PFD and the vertical speed bug is displayed on the vertical speed scale.

3 The reference vertical speed is changed by moving the PITCH wheel on the PC-400 autopilot controller, or by pushing and holding the TCS button and manually flying the aircraft to a new vertical speed reference and releasing the TCS button.

Figure 2-5-30. Vertical Speed Hold Mode

Table 2-5-12. Vertical Speed Hold Operating Limits

Parameter	Value
VS engage range	0 to ±6,000 ft/min
VS hold engage error	±30 ft/min
Pitch limit	±20°
Pitch rate limit	0.2 g (0.3 g overspeed)

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4 Input data for the vertical speed control law includes a vertical speed error term computed between the vertical speed hold target and the instantaneous vertical velocity. This indicates a pitch up correction is required.

(e) Vertical Speed Hold Mode Engage/Disengage Logic

1 Vertical Speed Hold Mode Engage Logic

a The vertical speed hold mode is engaged when:

- The VS button is pushed on the MS-560 mode selector.
- The vertical speed mode is not already engaged.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IC-615 IAC.

2 Vertical Speed Hold Mode Disengage Logic

a The vertical speed hold mode automatically disengages if any of the following conditions occur:

- The ALT, VS, or FLC buttons are pushed on the MS-560 mode selector.
- The go-around mode is selected.
- The glideslope is captured.
- The flight director captures the SRN VNAV.
- The flight director captures the FMS VNAV.
- The selected MADC source is changed.
- The computed MADC valid flag goes invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(f) Speed Hold Mode Engage/Disengage Logic

1 Speed Hold Mode Engage Logic

a The speed hold mode is engaged when:

- The VS button is pushed on the MS-560 mode selector.
- The vertical speed mode is not already engaged.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IAC.

2 Speed Hold Mode Disengage Logic

a The speed hold mode is automatically disengaged if any of the following conditions occur:

- The ALT, VS, or FLC buttons are pushed on the MS-560 mode selector.
- The go-around mode is selected.
- The glideslope is captured.
- The flight director captures the SRN VNAV.
- The flight director captures the FMS VNAV.
- The selected MADC source is changed.
- The computed MADC valid flag goes invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(g) Flight Level Change Mode

1 The FLC mode (Figure 2-5-31 and Table 2-5-13) enables the flightcrew to guide to a defined speed or Mach target from the present altitude to the preselected altitude. This is limited by the energy management feature of FLC that restricts the flight director from flying away from the altitude preselect target and ensures that at least 25 percent of the aircraft's potential energy is applied to the defined ascent or descent. The FLC mode also acts as an overspeed monitor and protection submode to the vertical speed and VNAV modes. The FLC mode runs concurrently with the vertical speed and VNAV modes, and computes and compares the aircraft state and flight director vertical mode command that corresponds with an overspeed condition. If the vertical speed or VNAV mode issues a command that violates the overspeed criteria, the FLC logic is activated as a submode to correct the aircraft state to nonoverspeed condition. The FLC mode engages immediately upon pushing the FLC button on the MS-560 mode selector. At this time, the IAS/Mach reference is synchronized to the IAS/Mach being flown. A new reference can be selected by using the pitch wheel on the autopilot controller. The aircraft then flies to the new reference.

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Figure 2-5-31. Flight Level Change Mode

Table 2-5-13. Flight Level Change Mode Operating Limits

Parameter	Value
FLC engage range	10 knots IAS to Vmo 0.4 Mach
FLC engage error	±5 knots IAS
Pitch command limit	±20°
Pitch rate limit	0.1 g (overspeed 0.3 g)

(h) FLC Mode Engage/Disengage Logic

1 FLC Mode Engage Logic

a The FLC mode is engaged when:

- The FLC button is pushed on the MS-560 mode selector.
- The autopilot is engaged.
- The FLC mode is not already engaged.
- The TCS is not engaged.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IAC.

2 FLC Mode Disengage Logic

a The SPD mode is automatically disengaged if any of the following conditions occur:

- The ALT, VS, or FLC buttons are pushed on the MS-560 mode selector.
- The go-around mode is selected.
- The altitude preselect is captured.
- The glideslope is captured.
- The flight director captures the SRN VNAV.
- The flight director captures the FMS VNAV.
- The autopilot is disengaged.
- The selected MADC source is changed.
- The computed MADC valid flag goes invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(i) Overspeed Protection

1 The overspeed protection mode may be automatically entered to supply overspeed protection during VNAV mode operation. Overspeed protection prevents the aircraft from exceeding Vmo limits imposed by the aircraft manufacturer. When aircraft IAS exceeds Vmo limits plus 5 knots, a Vmo limit is imposed and a MAX SPEED annunciation is displayed on the master PFD. If Vmo data from the selected MADC is invalid, a Vmo value of 277 knots is used.

(j) Altitude Preselect Mode

1 The ASEL mode (Figure 2-5-32 and Table 2-5-14) lets the flightcrew manually preselect an altitude reference target. ASEL displays the selected target on both the pilot's and copilot's PFD, provides aural and visual altitude approach alerting, and provides aural and visual altitude deviation warnings. At power-up, the flight director causes the cyan dashes to be displayed on the PFDs. The dashes remain until the ASEL knob is turned on the MFD bezel controller. When the knob is turned for the first time, the ASEL target is the barometric altitude supplied by the MADC source. After the first turn, the ASEL target increments or decrements at 100-ft intervals for each detent in the ASEL knob. The desired barometric altitude reference is entered in the altitude alert display window above the altitude scale on the PFD. The flight director causes the ASEL target to be displayed as amber dashes if either the selected MADC source or the DC-550 display controller data valid flags are set to invalid.

2 Approach Alert

a The altitude approach alert issues a visual and aural warning when the aircraft approaches to within approximately 1,000 ft of the preselected altitude target reference. The altitude visual approach alert consists of a color change of the PFD's altitude target window from cyan to amber. The audio alert consists of a 1-second aural tone.

3 Altitude Alert Annunciators

a As the aircraft approaches to within 1,000 ft of the preselected altitude, the visual alerts are activated and the horn sounds for one second. The visual alerts remain active until the aircraft approaches to within 200 ft of the preselected altitude. Once the preselected altitude is acquired, any deviation of more than 200 ft in magnitude from the preselected altitude results in the visual alerts becoming active and the horn sounding for one second. The visual alerts then remain active until the ASEL knob on the MFD bezel controller is adjusted.

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4 Master Flight Director

a The master flight director determines the distance from the altitude preselect target by taking the difference between the altitude preselect target and the master-side selected MADC barometric altitude. The master flight director issues a visual altitude approach alert to its associated PFD display when the magnitude of the aircraft distance from the altitude preselect target reference is less than 990 ft and all of these conditions are met:

- A valid altitude preselect target has been selected.
- The ASEL knob on the MFD bezel controller has been turned at least once.
- The master selected MADC data valid flag is set to valid.
- The master DC-550 display controller data valid flag is set to valid.
- The ILS glideslope is not captured.

b The master visual approach alert is cancelled if any of these conditions are met:

- The magnitude of the aircraft distance from the altitude preselect target is less than 190 ft.
- The master selected MADC data valid flag is set to valid.
- The master DC-550 display controller data valid flag is set to valid.
- The ILS glideslope has been captured.
- The altitude preselect target reference has changed such that the magnitude of the aircraft distance from the altitude preselect target is greater than 1,010 ft.
- The altitude preselect target reference has changed such that the magnitude of the distance to the altitude preselect target is less than 190 ft.

c The master flight director issues an aural altitude approach alert to the aircraft horn for 1 second when the magnitude of the aircraft distance from the altitude preselect target is less than 990 ft and all of these conditions are met:

- A valid altitude preselect target has been selected.
- The master selected MADC data valid flag is set to valid.
- The master DC-550 display controller data valid flag is set to valid.
- The ILS glideslope is not captured.
- The ASEL knob on the MFD bezel controller has not been changed within the last 1 second.

d The aural altitude approach alert horn is cancelled if any of the following conditions are met:

- The master selected MADC data valid flag is set to invalid.
- The master DC-550 display controller data valid flag is set to invalid.
- The ILS glideslope has been captured.
- The ASEL knob on the MFD bezel controller has been changed within the last 1 second.

e The master flight director issues a visual altitude deviation alert to its associated PFD display when the magnitude of the aircraft distance from the altitude preselect target reference is greater than 210 ft and all of the following conditions are met:

- A valid altitude preselect target has been selected.
- The ASEL knob on the MFD bezel controller has been turned at least once.
- The master selected MADC data valid flag is set to valid.
- The master DC-550 display controller data valid flag is set to valid.
- The ILS glideslope is not captured.

f The master visual altitude deviation alert is cancelled if any of these conditions are met:

- The magnitude of the aircraft distance from the altitude preselect target is less than 190 ft.
- The master selected MADC data valid flag is set to invalid.
- The master DC-550 display controller data valid flag is set to invalid.
- The ILS glideslope has been captured.
- The altitude preselect target reference has changed such that the magnitude of the aircraft distance from the altitude preselect target is greater than 1,010 ft.
- The altitude preselect target reference has changed such that the magnitude of the distance to the altitude preselect target is less than 190 ft.

g The master flight director issues an aural altitude deviation alert to the aircraft horn for 1 second when the magnitude of the aircraft distance from the altitude preselect target is greater than 210 ft and all of the following conditions are met:

- A valid altitude preselect target has been computed.
- The master selected MADC data valid flag is set to valid.
- The master DC-550 display controller data valid flag is set to valid.
- The ILS glideslope is not captured.
- The ASEL knob on the MFD bezel controller has not been changed within the last 1 second.

h The aural altitude approach alert horn is cancelled if any of the following conditions are met:

- The master selected MADC data valid flag is set to invalid.
- The master DC-550 display controller data valid flag is set to invalid.
- The ILS glideslope has been captured.
- The ASEL knob on the MFD bezel controller has been changed within the last 1 second.

5 Slave Flight Director

a The slave flight director operates in the same manner as the master flight director, except that it does not issue an aural approach alert.

6 Altitude Deviation Alert

a The altitude deviation alert issues a visual and aural warning when the aircraft deviates from the captured altitude preselect target reference by more than approximately 200 ft. The altitude deviation visual alert consists of a color change from cyan to amber in the altitude target window of both PFDs. The aural alert consists of a 1-second tone from the horn.

b Figure 2-5-32 shows a descent from 18,000 ft in the ASEL mode.

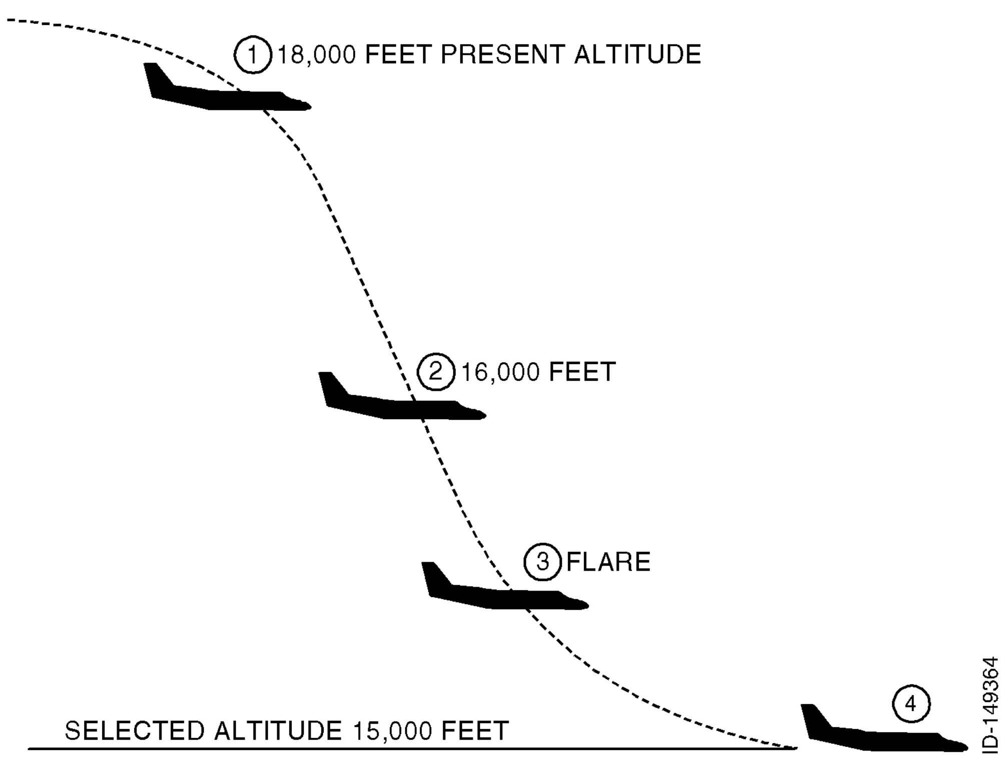

Figure 2-5-32. ASEL Mode Pictorial

7 The sequence of events described below are keyed to Figure 2-5-33 thru Figure 2-5-36 to illustrate how the aircraft is flown to a preselected altitude using the ASEL mode.

a The pilot/copilot sets the selected altitude with the ASEL knob on the MFD bezel controller. The digital readout of the ASEL altitude is displayed in the ASEL window above the altitude scale on the PFD. (See Figure 2-5-33.)

b The pilot/copilot sets either the VS or FLC (SPD) button on the MS-560 mode selector and sets the vertical speed value for vertical speed mode or the airspeed value for FLC mode using the pitch wheel on the autopilot controller. (See Figure 2-5-34.)

c The altitude flare point (ASEL CAP) is dependent on vertical speed. (See Figure 2-5-35.)

d The ASEL capture is dropped when the altitude error is less than 25 ft and the altitude rate is less than 5 ft/s. When these conditions exist, ALT HOLD is automatically engaged. (See Figure 2-5-36.)

Figure 2-5-33. Prior to Descent - Altitude Hold Mode

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Figure 2-5-34. During Descent - ASEL Armed Mode

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Figure 2-5-35. Start of Flare - ASEL Capture

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Figure 2-5-36. Level at New Altitude - Altitude Hold Mode

8 The ASEL capture mode is canceled by any of the following:

- The ASEL knob on the MFD bezel controller has been turned at least once.
- Any other vertical mode is selected or captured (except glideslope arm).
- The go-around mode is selected.

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Table 2-5-14. ASEL Mode Operating Limits

Parameter	Value
ASEL capture range	-900 to 45,000 ft
Maximum vertical speed for capture	±6,000 ft/min
Maximum gravitational force during capture maneuver	±0.2 g
Pitch command limit	±20°
Pitch rate limit	f(TAS)

(k) ALT Hold Mode

1 The ALT hold mode (Figure 2-5-37 and Table 2-5-15) lets the flightcrew acquire and maintain a desired altitude target. The desired altitude can be chosen by selecting the ASEL function, by engaging the autopilot, by selecting the altitude hold button on the MS-560 mode selector, or by using TCS to fly to the desired altitude and then releasing. If the ALT mode is selected through the MS-560 mode selector, the flight director immediately transitions to the ALT hold phase. If the ALT mode is selected through the ASEL option, three distinct phases are entered. The phases are ALT arm, ALT capture, and ALT hold.

(l) ALT Mode Target

1 If the altitude hold phase has not yet been engaged, the ALT target is considered to be the defined ASEL target. The ASEL target is used in the arm, capture, and hold phase. If the ALT hold phase has not been engaged and the flightcrew selects the the ALT mode via the MS-560 mode selector, the flight director uses the value of the barometric altitude at the time of ALT mode entry as the target altitude. If the ALT hold phase is already active, the flight director uses the current value of the barometric altitude as the target altitude if the autopilot transitions from disengaged to engaged status, and TCS switching transitions from engaged to disengaged status.

(m) ALT Arm Phase Engagement

1 The ALT arm phase engages when an ASEL target is defined and the aircraft has begun a climb or descent to the target. The flight director engages the ALT arm phase when all of the following requirements are met for at least 3.0 seconds:

- The ASEL target has been defined.
- The ASEL target is not being slewed.
- The aircraft is either climbing or descending to the target.
- The vertical rate is at least 60 ft/min in magnitude.
- Neither the ALT capture nor the ALT hold phases are active.
- The glideslope mode is not active.
- The on-ground initiated test is not active.
- The FMS has not suppressed the ASEL arming.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set to valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IC-615.

(n) ALT Arm Phase Disengagement

1 The ALT arm phase disengages when any of the following requirements are met:

- The ALT button on the MS-560 mode selector is pushed.
- The go-around mode is selected.
- The glideslope is captured.
- The FMS is suppressing the ASEL arming.
- The altitude target is being slewed.
- The selected MADC source is changed.
- The computed MADC valid flag is set to invalid.
- The flight director is in master/slave status changes.
- The flight director has reverted to the cross-side IC-615.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IC-615 fails to transmit (IC-615 failure).

(o) ALT Capture Phase Engagement

1 The ALT capture phase engages when the ALT capture transition criteria has been met and the following requirements are met:

- The ALT arm phase is active.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set to valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IC-615.

(p) ALT Capture Phase Disengagement

1 The ALT capture phase disengages when any of the following requirements are met:

- The ALT button on the MS-560 mode selector is pushed.
- The go-around mode is selected.
- The glideslope is captured.
- The FMS is suppressing the ALT mode.
- The altitude target is being slewed.
- The selected MADC source is changed.
- The computed MADC valid flag is set to invalid.
- The flight director is in master/slave status changes.
- The flight director has reverted to the cross-side IC-615.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IC-615 fails to transmit (IC-615 failure).

(q) ALT Hold Phase Engagement

1 The ALT hold phase engages automatically when the ALT hold transition criteria has been met and the following requirements are met:

- The ALT capture phase is active.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set to valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IC-615.

2 The ALT hold phase engages when the ALT button on the MS-560 mode selector is pushed and the following requirements are met:

- The flight director is not already in the ALT hold phase.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The computed MADC valid flag is set to valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IC-615.

(r) ALT Hold Phase Disengagement

1 The ALT hold phase disengages when any of the following requirements are met:

- The ALT, VS, or FLC button on the MS-560 mode selector is pushed.
- The go-around mode is selected.
- The glideslope, flight director VNAV path, or FMS VNAV is captured.
- The pitch wheel on the autopilot controller is rotated.
- The FMS is suppressing the ALT mode.
- The selected MADC source is changed.
- The computed MADC valid flag is set to invalid.
- The flight director is in master/slave status changes.
- The flight director has reverted to the cross-side IC-615.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IC-615 fails to transmit (IC-615 failure).

Figure 2-5-37. ALT Hold Mode

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Table 2-5-15. ALT Hold Mode Operating Limits

Mode	Parameter	Value
ALT	ALT capture range	0 to 45,000 ft
	ALT hold capture error	±20 ft
	Pitch limit	±12°
	Pitch rate limit	f(TAS) 0.3 g max

(s) ILS Glideslope Mode

1 See Figure 2-5-38 thru Figure 2-5-43, and Table 2-5-16.

2 The vertical portion of the approach mode is used for the automatic intercept, capture, and tracking of the glideslope beam. The beam is used to guide the aircraft down to the runway in a linear descent, as shown in Figure 2-5-38. Typical glideslope beam angles vary between two and three degrees, dependent on local terrain. When the glideslope mode is used as the vertical portion of the localizer approach mode, it lets the pilot fly a fully coupled ILS approach. The mode is interlocked, so glideslope capture is inhibited until localizer capture has occurred.

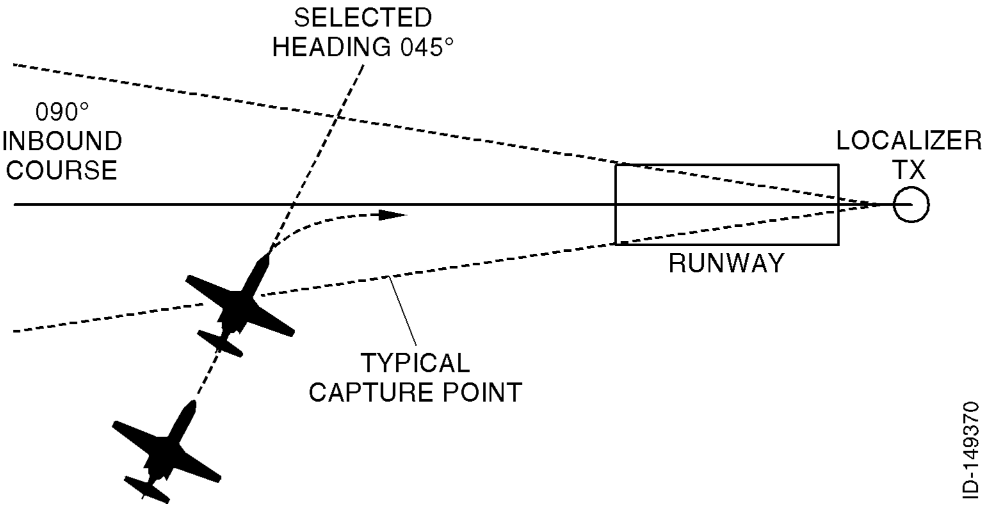

Figure 2-5-38. ILS Approach (LOC/GS) Arm Pictorial

3 The ILS approach mode is initiated by pushing the APR and NAV buttons on the master MS-560 mode selector, with ILS as the onside NAV source. The master PFD, as shown in Figure 2-5-39, annunciates the following modes:

- LOC in white.
- GS in white.

4 With the localizer captured and outside the normal glideslope capture limits, the master PFD, as shown in Figure 2-5-40, annunciates the following modes:

- LOC in green (enclosed with a white box for 5 seconds)
- GS in white
- Any other vertical mode in use at this time is also displayed.

5 The NAV and APR mode selector buttons on the master MS-560 mode selector are also annunciated.

Figure 2-5-39. ILS Approach (LOC/GS) Arm

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Figure 2-5-40. ILS Approach Mode - Localizer Capture

6 As the aircraft approaches the glideslope beam, as shown in Figure 2-5-41, the VBS monitors TAS, vertical speed, and glideslope deviation in determining the correct capture point. At glideslope capture, the flight director drops any other vertical mode that was in use, and automatically generates a pitch command to smoothly track the glideslope beam.

7 At this time, the master PFD annunciates LOC in green and GS in green, as shown in Figure 2-5-42. This annunciation is enclosed with a white box for 5 seconds.

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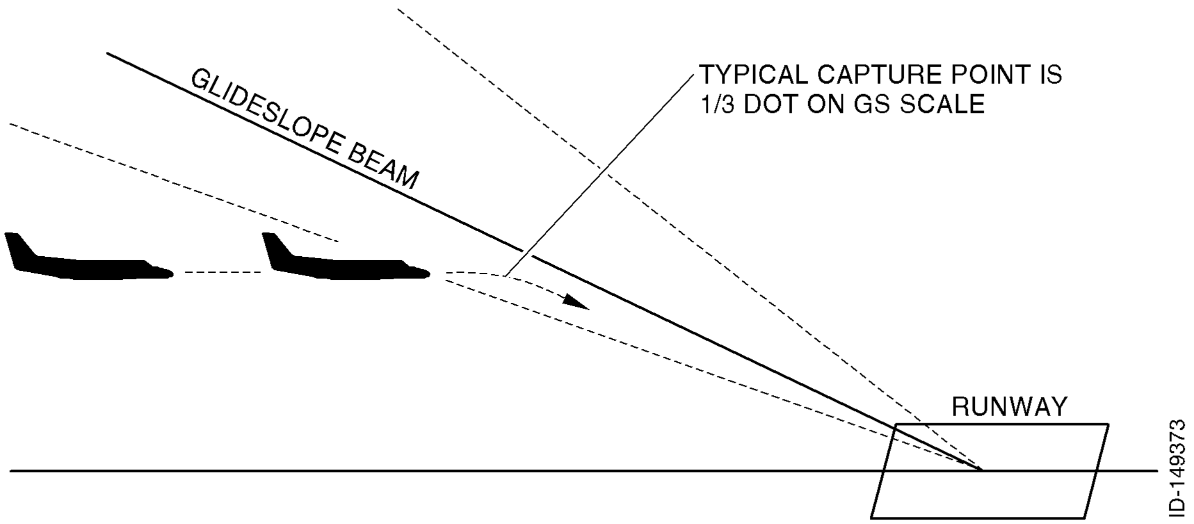

Figure 2-5-41. ILS Glideslope Tracking Pictorial

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Figure 2-5-42. ILS Glideslope Tracking

8 Gain programming is performed on the glideslope signal to compensate for the aircraft closing on the glideslope antenna, and beam convergence caused by the directional properties of the glideslope antenna, as shown in Figure 2-5-43. Glideslope programming is normally accomplished as a function of the change in radio altitude on the approach.

9 If radio altitude is not valid or not available, glideslope gain programming starts at glideslope capture and runs down as a function of TAS and time. At the middle marker, the gain is synchronized to a preset value for the remainder of the approach.

10 Input data used in the glideslope control law includes glideslope deviation, radio altitude, airspeed, vertical speed, and middle marker.

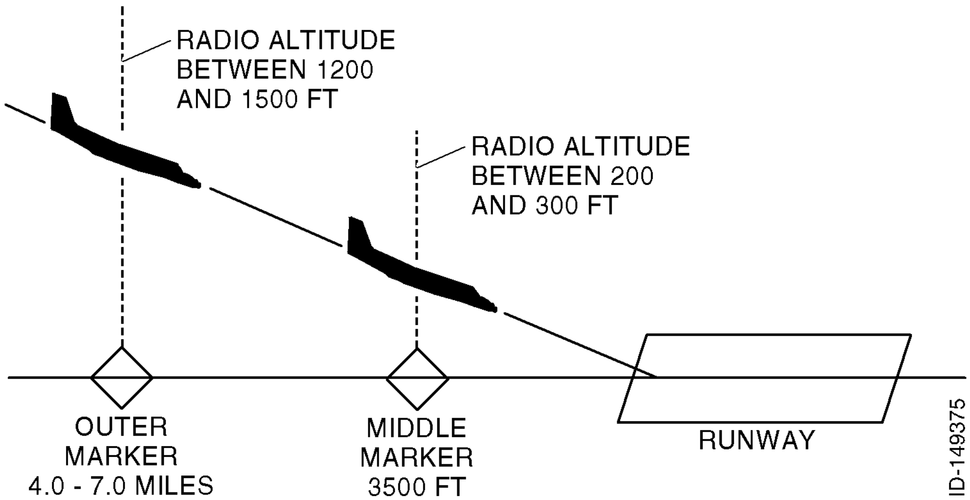

Figure 2-5-43. ILS Glideslope Gain Programming

11 The glideslope approach mode is canceled by any of the following:

- The ALT, VS, APR or FLC buttons are pushed on the MS-560 mode selector.
- The go-around mode is selected.
- The LOC mode is disengaged.
- The selected navigation source is changed.
- The computed MADC valid flag goes invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

Table 2-5-16. ILS Glideslope Mode Operating Limits

Parameter	Value
Beam capture	< 150 mV glideslope deviation
Pitch command limit	$\pm 10^\circ$
Path damping	Vertical acceleration
Pitch rate limit	f(TAS)
Normal acceleration limit	0.2 g
Gain programming (first stage)	Starts at 1,200 ft radio altitude, gain reduction = 1 to 0.164 at 200 ft

(t) ILS Glideslope Mode Engage/Disengage Logic

1 ILS Glideslope Arm Engage Logic

a The glideslope arm is engaged when the following conditions are met:

- The APR button is pushed on the MS-560 mode selector
- The flight director is not already in the glideslope mode.
- The selected navigation source is an ILS.
- Localizer mode arm, capture, or hold is active.
- The computed MADC valid flag is set.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director status is master.
- The flight director has not reverted to the cross-side IAC.

2 ILS Glideslope Arm Disengage Logic

a The glideslope arm mode is automatically disengaged if any of the following conditions occur:

- The APR button is pushed on the MS-560 mode selector.
- The go-around mode is selected.
- The LOC mode is disengaged.
- The selected navigation source is changed.
- The computed MADC valid flag goes invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

3 ILS Glideslope Capture Engage Logic

a The ILS glideslope capture is engaged when the aircraft glideslope beam capture rate requires the flight director to execute a flare maneuver away from the beam, or the aircraft falls within the minimum glideslope beam deviation criteria of 0.10 degree. In addition, the following conditions must be met:

- The selected navigation source is an ILS.
- The computed MADC valid flag is set.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director status is master.
- The flight director has not reverted to the cross-side IAC.

4 ILS Glideslope Capture Disengage Logic

a The ILS glideslope capture mode is automatically disengaged if any of the following conditions occur:

- The ALT, VS, FLC, or APR buttons are pushed on the MS-560 mode selector.
- The go-around mode is selected.
- The LOC mode is disengaged.
- The selected navigation source is changed.
- The computed MADC valid flag goes invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

5 ILS Glideslope Track Engage Logic

a The ILS glideslope track engage logic computes the pitch guidance commands necessary to track the selected glideslope until the glideslope mode is dropped. During the glideslope track, the flight director issues pitch steering commands to the flightcrew through the pitch flight director bar, and to the autopilot through the pitch steering commands if the autopilot is engaged. To engage the track mode, the following conditions must be met:

- The selected navigation source is an ILS.
- The computed MADC valid flag is set.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director status is master.
- The flight director has not reverted to the cross-side IAC.

b With the above conditions satisfied, the ILS glideslope mode automatically transitions from capture to track.

c ILS glideslope track automatically is reset for the same conditions as ILS glideslope capture reset.

6 ILS Glideslope Track Disengage Logic

a The ILS glideslope track mode automatically disengages for the same reasons as ILS glideslope capture disengage.

(u) VNAV Mode

1 See Figure 2-5-44, Figure 2-5-45, and Table 2-5-17.

2 The VNAV mode can only be used with the VNAV control menu on the MFD to define a climb or descent profile to a vertical waypoint ahead of the aircraft. The vertical waypoint is defined based on a distance reference TO or FROM a VOR station or LRN waypoint. At the proper time, the VNAV mode automatically transitions to ASEL capture and then to altitude hold at the waypoint altitude.

3 To set up the VNAV profile, the pilot performs the following:

- Select the navigation source (VOR or FMS)
- Set, capture, and track the lateral course or desired track
- If VOR/DME is being used, verify that the DME is not in HOLD
- On the MFD bezel menu, set the following:
  - Waypoint altitude
  - VOR station or waypoint elevation above sea level
  - Select TO or FROM and set the along track distance.

4 At this point, if a valid VNAV profile has been established, the computed VANG is displayed on the MFD menu. If desired, the pilot can change the displayed VANG by boxing the value and turning the set knob on the MFD. The VANG can be set between 0.1 and 6.0 degrees in 0.1-degree increments.

5 Once the VNAV profile has been defined, the pilot pushes the VNAV button on the master MS-560 mode selector. The VNAV mode immediately goes into capture and the aircraft flies the VANG to the defined waypoint altitude. If the pilot has selected an intercept point ahead of the aircraft by increasing the VANG, the flight director stays in the current vertical mode until the intercept point is reached.

6 With VNAV captured, the altitude horn sounds one minute prior to reaching the waypoint altitude flare point. With ASEL captured and within 25 ft of the waypoint altitude and vertical speed less than 300 ft per minute, altitude hold automatically comes on.

7 At any time while the VNAV mode is captured, the VNAV parameters are frozen. Changing the ASEL altitude cancels the VNAV mode. After the aircraft is level at the waypoint altitude and in altitude hold, the VNAV profile is erased.

Figure 2-5-44. VNAV Mode Menu Select

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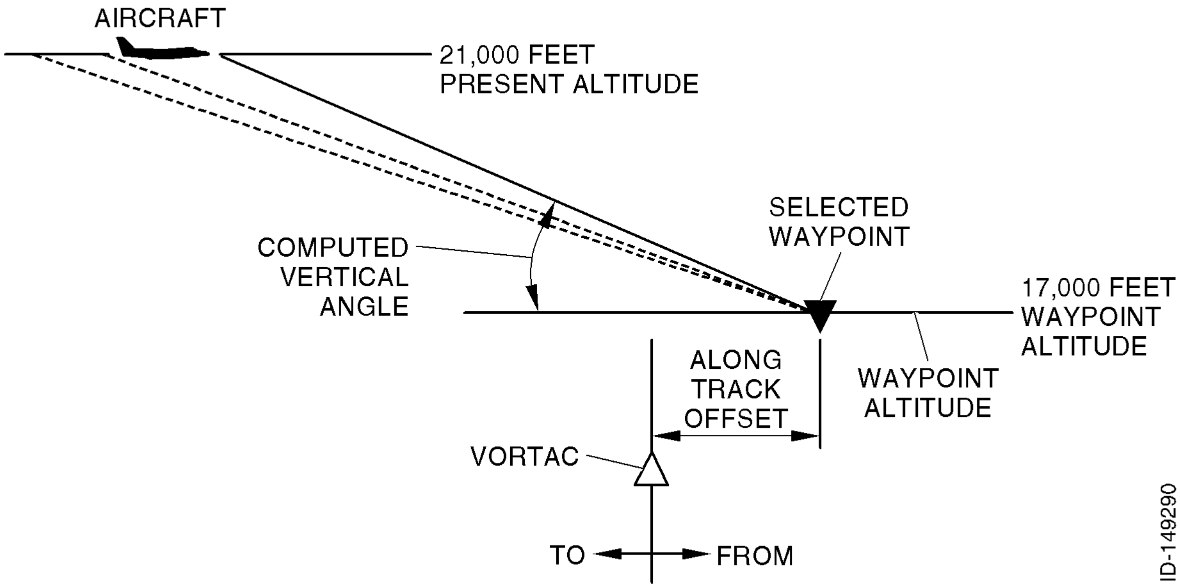

Figure 2-5-45. VNAV Preselect Plan View

Table 2-5-17. VNAV Mode Operating Limits

Mode	Parameter	Value
Single point VNAV	Altitude range path	0 to 45,000 ft
	Angle range	±6°, one vertical waypoint
	Elevation range	0 to 10,000 ft
	Bias range	±99.9 NM from VOR, FMS
	Pitch command limit	±15°
	Pitch rate limit	0.1 g (overspeed 0.3 g)
FMS VNAV steering command	Pitch limit	±20°
	Pitch rate limit	f(TAS)

(v) VNAV Capture Phase Mode Engage/Disengage Logic

1 The VNAV capture phase mode engage logic computes the pitch guidance commands necessary to track the selected VNAV flightpath profile until the VNAV mode is dropped. During the VNAV capture phase, the flight director issues pitch steering commands to the flightcrew through the pitch flight director bar, and to the autopilot through the pitch steering commands if the autopilot is engaged.

2 VNAV Capture Phase Mode Engage Logic

a To engage the VNAV capture phase mode, the following conditions must be met:

- The flight director is not already in the VNAV capture or arm phase.
- A valid VNAV flightpath profile exists.
- The flight director considers the aircraft to be closing on the navigation source (estimated groundspeed is less than 0) within the previous 1.0 second.
- The altitude preselect target has not been changed within the previous 1.0 second.
- The navigation source distance validity has been in the valid state within the previous 5.0 seconds.
- If the navigation source is a VOR, the DME distance jump between frames is less than 2.0 NM and either a TO or FROM signal is provided by the selected VOR source.
- If the navigation source is an FMS, the filtered range error is less than 4.0 NM within the previous 0.20 second.
- The computed MADC flag is set.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director status is master.
- The flight director has not reverted to the cross-side IAC.

3 VNAV Capture Phase Mode Disengage Logic

a The VNAV capture phase mode is automatically disengaged if any of the following conditions occur:

- The VNAV, ALT, VS, or FLC button on the MS-560 mode controller is pushed.
- The go-around mode is selected.
- The altitude preselect capture is engaged.
- The VNAV track status is set and the magnitude of the aircraft altitude deviation from the VNAV flightpath is 1,000 ft or greater for 1.0 second or longer.
- If the navigation source is a VOR, the DME distance jump between frames is greater than or equal to 2.0 NM, or the selected VOR indicates that the aircraft is flying TO the navigation source, but the VNAV problem was initialized in a FROM status.
- The selected VOR indicates that the aircraft is flying FROM the navigation source, but the VNAV problem was initialized in a TO status and the flight director has not detected an over station status.
- If the selected navigation source is an FMS, a change was made to the FMS flight plan.
- A filtered range error is greater than or equal to 4.0 NM for 0.20 seconds or longer.
- The flight director sees a step change in the FMS distance update of 2.0 NM or more, and the previous FMS distance to the waypoint was 12.0 NM or more.
- The selected navigation source was changed.
- The computed MADC valid flag is invalid.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

(w) Go-Around Mode (Wings Level)

1 The go-around mode (Figure 2-5-46) is normally used to transition from an approach to a climbout condition in the event of a missed approach. The mode is selected by pushing the GA button located on the pilot's throttle handle. With go-around selected, all flight director modes are cancelled, the autopilot is disengaged, and the PFD displays GA. The go-around command is wings level laterally and a 12-degree climb angle.

Figure 2-5-46. Go-Around Mode

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(x) Go-Around Mode Engage/Disengage Logic

1 Go-Around Mode Engage Logic

a The go-around mode is engaged if the following conditions are met:

- The go-around remote switch is engaged.
- The flight director is in master status.
- The DC-550 display controller is valid.
- The primary pitch attitude source is valid.
- The primary roll attitude source is valid.
- The flight director has not reverted to the cross-side IAC.

2 Go-Around Mode Disengage Logic

a The go-around mode automatically disengages if any of the following conditions occur:

- The ALT, VS, or FLC buttons on the MS-560 mode selector are pushed.
- The TCS is engaged.
- The autopilot is engaged.
- The glideslope is captured.
- The flight director captures the SRN VNAV.
- The flight director captures the FMS VNAV.
- The flight director master/slave status changes.
- The flight director is reverted to the cross-side IAC.
- The DC-550 display controller is invalid.
- The primary pitch attitude source is invalid.
- The primary roll attitude source is invalid.
- The flight director has determined that its ICB has failed.
- The opposite side IAC fails to transmit (IC-615 failure).

4. Fault Monitoring

A. General

(1) Loss of valid flight director data from the master IC-615 IAC causes the following indications, shown in Figure 2-5-47:

- An amber FD FAIL warning annunciator is displayed at the top left of the ADI in the flight director lateral annunciator location.
- The flight director cue and all flight director mode annunciators are removed.

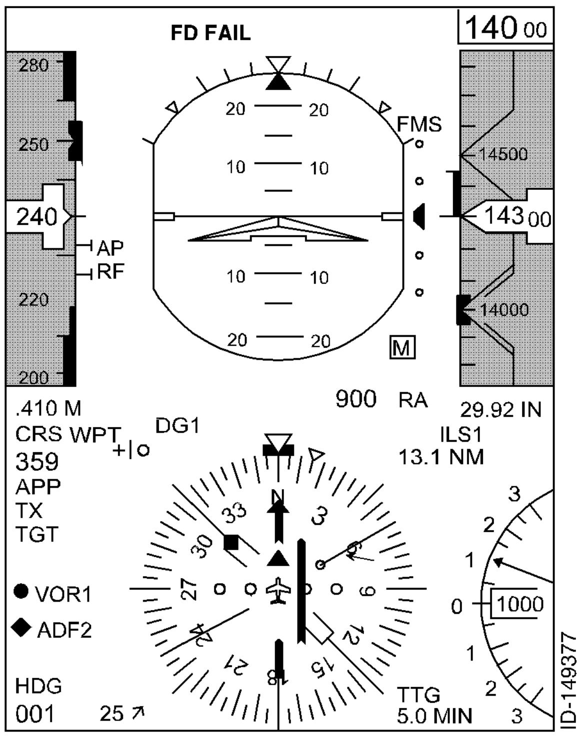

Figure 2-5-47. Flight Director Failure Indications

SECTION 2-6
AUTOPILOT/YAW DAMPER SYSTEM

1. Overview

A. General

(1) The PRIMUS 1000 Integrated Avionics System features a single autopilot/yaw damper system designed around a distributed processor architecture, which uses independent hardware elements to perform the aircraft control and monitor functions. The monitor function is performed in the primary (flight director/EDS) processor within the IC-615 IAC No. 1, while the aircraft control function is performed in the secondary (autopilot/yaw damper) processor.

(2) This architecture ensures that any single failure does not cause a condition which would prevent continued safe flight and landing of the aircraft. In the event of a primary processor failure, the secondary processor becomes unavailable for use, since the monitor functions are housed in the primary processor. If the secondary processor fails, the functions of the primary processor are still available.

(3) The No. 1 IC-615 IAC houses the autopilot/yaw damper CCAs. Only the No. 1 IC-615 IAC is connected to the servos; consequently, this configuration supplies single autopilot/yaw damper operation.

(4) The PRIMUS 1000 autopilot/yaw damper system requires that the AHRS in the aircraft be operating and valid.

(5) The primary processor supplies dedicated disconnect hardware for the monitor function. This lets either processor force a disconnect of the autopilot and yaw damper. All automatic disconnects resulting from monitor trips are stored in nonvolatile memory for later recall during ground maintenance test.

B. Autopilot

(1) The PRIMUS 1000 autopilot is housed in the pilot's IC-615 IAC and is of a fail-passive design, featuring digital attitude and servo loops. The autopilot supplies attitude stabilization and tracking of pitch and roll steering commands from the flight director. The autopilot is not aware of which flight director mode(s), if any, are active. The autopilot simply tracks the pitch and roll steering commands as attitude changes.

(2) The autopilot supplies aircraft stabilization around a pilot-selected reference. With the autopilot engaged, short-term transient disturbances are automatically corrected. As the aircraft is moved away from its reference by a disturbance, the autopilot works to stop the aircraft from moving away and return it to its reference position/attitude.

(3) The pitch axis autopilot trim function resides in the pilot's IC-615 IAC and works to maintain aircraft pitch attitude against long-term attitude disturbances, such as fuel burn and passenger movement. Activation of the manual electric trim switches causes the autopilot to disengage.

(4) For the autopilot to do its job, it requires the following data:

- What is the pilot's desired attitude reference?
- What is the aircraft's actual attitude?
- If there is a difference between desired and actual attitude, correct for the difference and control the rate at which the correction takes place.

C. Yaw Damper

(1) The yaw damper computes servo commands based on sensor input data only. It supplies yaw rate damping and makes no effort to control the flightpath of the aircraft. While the yaw damper can be engaged without the autopilot, the autopilot cannot be engaged without the yaw damper.

(2) Servo position reference is synchronized to zero at engagement and is constantly washed out to ensure that steady-state rudder forces are zero. If the rudder trim position changes due to pilot input or aircraft configuration changes, the rudder washes out the steady-state force and rudder servo resynchronization occurs.

D. Autopilot/Yaw Damper System

(1) The PRIMUS 1000 autopilot/yaw damper system is made up of the following LRUs:

- IC-615 IAC (pilot's)
- PC-400 autopilot controller
- LCR-93 AHRS
- SM-200 servos and servo brackets (aileron, elevator, rudder)
- Aircraft primary trim system.

(2) The autopilot/yaw damper system requires inputs from the following sensors:

- LCR-93 AHRS
- AZ-950 MADC.

(3) Autopilot modes of operation are as follows:

- Heading hold and wings level
- Roll hold
- Pitch attitude hold
- Flight director coupled
- Turn.

(4) The autopilot/yaw damper off discrete output logic supplies a 2.0-second autopilot off output for the warning horn for normal autopilot disconnects, and a continuous output for any automatic disconnect. The continuous output can be reset by holding the autopilot disconnect on the control wheel for more than 1 second.

2. Component Descriptions and Locations

A. IC-615 IAC

(1) Two IC-615 IACs are located in the nose compartment. Figure 2-6-1 shows a graphical view of the IC-615 IAC. Table 2-6-1 gives items and specifications particular to the computer.

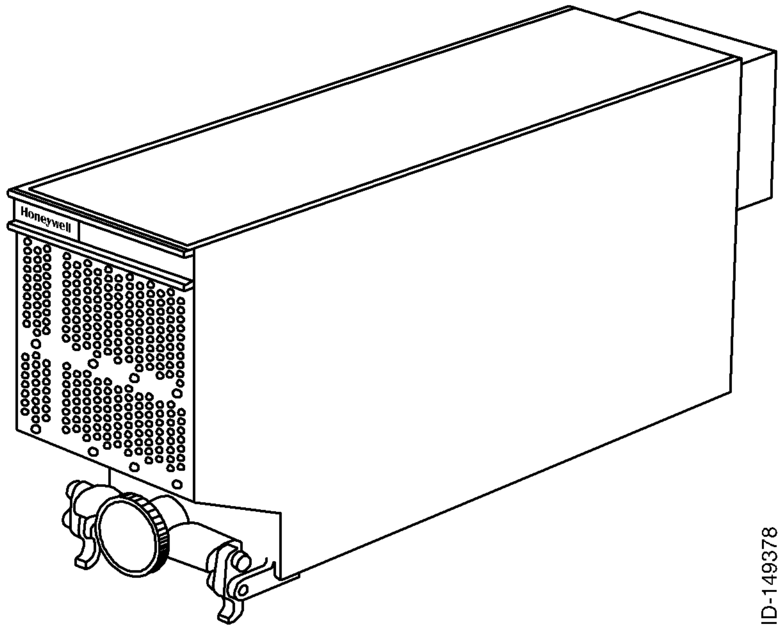

Figure 2-6-1. IC-615 IAC (Autopilot Function)

Table 2-6-1. IC-615 IAC Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	7.62 in. (193.55 mm)
• Width	4.13 in. (104.90 mm)
• Length	16.45 in. (418.83 mm)
Weight (maximum):	
• With autopilot	15.5 lb (7.05 kg)
• Without autopilot	15.0 lb (6.82 kg)

Table 2-6-1. **IC-615 IAC Leading Particulars** (cont)

Item	Specification
Power requirements (with autopilot):	
• Continuous	28 V dc, 50 W (max)
• In-rush	28 V dc (0.5 sec), 200 W (max)
• Servo power	28 V dc, 210 W (max)/112 W (nom)
Power requirements (without autopilot):	
• Continuous	28 V dc, 50 W (max)
• In-rush	28 V dc (0.5 sec), 200 W (max)
User replaceable parts	
• Battery	HPN 7020116-1
Mating connectors (J1, J2)	ITT Cannon Part No. DPX2MA-A106P-A106P-33B-0001 NOTE: Sunbank backshell (4) required: Part No. J1560-12-2
Mounting	HPN 7017095-902

(2) The primary component of the PRIMUS 1000 autopilot/yaw damper system is the pilot's IC-615 IAC. The autopilot/yaw damper processor in the pilot's IC-615 IAC supplies pitch and roll attitude commands through control of elevator, aileron, and trim servos, as well as yaw rate terms to the rudder servo. The autopilot tracks pitch and roll attitude commands from the flight director computed flightpath steering. The FD1/FD2 switch on the instrument panel lets the pilot select which flight director(pilot/copilot) is coupled to the autopilot.

(3) In addition to supplying stabilization around a pilot-defined reference, the autopilot processor also supplies the following:

- Power-up/start-up initialization
- Engage/disengage logic
- Airspeed gain computations
- I/O data management
- ARINC 429 communications
- Continuous testing functions.

B. PC-400 Autopilot Controller

(1) The PC-400 autopilot controller is located on the pedestal. The PC-400 autopilot controller is used to engage/disengage the autopilot and yaw damper, as well for manual control of the autopilot through PITCH wheel and TURN knob inputs. Figure 2-6-2 shows a graphical view of the PC-400 autopilot controller. Table 2-6-2 gives items and specifications particular to the controller.

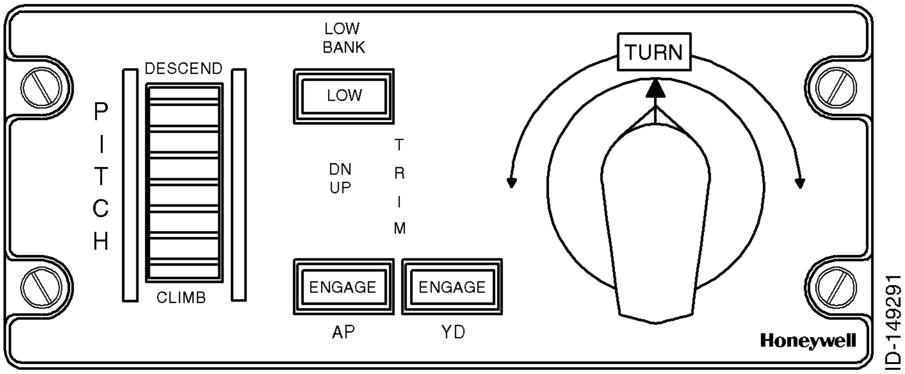

Figure 2-6-2. PC-400 Autopilot Controller

Table 2-6-2. PC-400 Autopilot Controller Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	2.625 in. (6.67 cm)
• Width	5.750 in. (14.60 cm)
• Length	6.150 in. (15.62 cm)
Weight (maximum)	1.6 lb (0.73 kg)
Power requirements:	
• Instrument lighting	5 V ac or dc
• Mode switches	28 V dc
User replaceable parts:	
• Knob, turn	HPN 337136-1
• Setscrew, bottom (hex socket, 8-32 x 5/8 in., cup point)	HPN 0455-284
• Setscrew, side (hex socket, 8-32 x 3/16 in., cup point)	HPN 0455-274
• Lamp, clear (Type 7341)	HPN 0635-22
Mating connector J1	MS3126F20-41S
Mounting	Standard Dzus rail

(a) AP Button

1 Pushing the AP button engages the autopilot and yaw damper simultaneously. When engaged, both the AP and YD buttons are lit. With the autopilot and yaw damper engaged, pushing the AP button again disengages the autopilot only. The yaw damper stays engaged.

(b) YD Button

1 Pushing the YD button engages the yaw damper only. When engaged, the YD button is lit. With the yaw damper engaged, pushing the YD button again disengages the yaw damper. With the autopilot and yaw damper both engaged, pushing the YD button disengages both the autopilot and yaw damper.

(c) Low Bank Button

1 The low bank button is for the flight director heading select mode only. Pushing the low bank button with the heading select mode active lowers the maximum bank angle for the mode to 14 degrees. When the low bank button is active, LOW is lit in the button. Pushing the low bank button when LOW is lit removes the lower bank angle limit and LOW is no longer lit.

(d) UP or DN Annunciators

1 The UP or DN annunciators light to indicate a sustained request for elevator trim. The annunciators remain lit as long as the request for trim is present.

(e) PITCH Wheel

1 With the autopilot engaged, moving the PITCH wheel changes the pitch attitude of the aircraft proportional to the amount of PITCH wheel rotation and in the direction of PITCH wheel rotation. Moving the PITCH wheel with altitude hold on, or ASEL capture, cancels these modes and the aircraft follows the PITCH wheel. When vertical speed or speed is the selected flight director mode, moving the PITCH wheel changes the vertical speed or speed reference. The PITCH wheel input to the flight guidance system is inhibited when ILS approach is active and the glideslope is either in the capture or track phase of operation.

(f) TURN Knob

1 Moving the TURN knob out of its center detent position, with the autopilot engaged, commands a turn in the direction of TURN knob rotation and proportional to the amount of rotation. With the autopilot engaged, moving the TURN knob out of center cancels any active lateral flight director mode. The TURN knob must be in its center detent position to engage the autopilot.

C. SM-200 Servo Drive and SB-201 Servo Bracket

(1) The SB-201 servo bracket is firmly bolted to the aircraft airframe and the drum is connected to the aircraft's primary control rigging through cables. The SM-200 servo drive, with a spline output on the clutch, mates with the drum and bracket and may be removed from the drum and bracket without disturbing the aircraft rigging. Figure 2-6-3 shows a graphical view of the SM-200 servo drive and SB-201 servo bracket. Table 2-6-3 gives items and specifications particular to the servo drive and bracket. Table 2-6-4 gives the servo dash number differences.

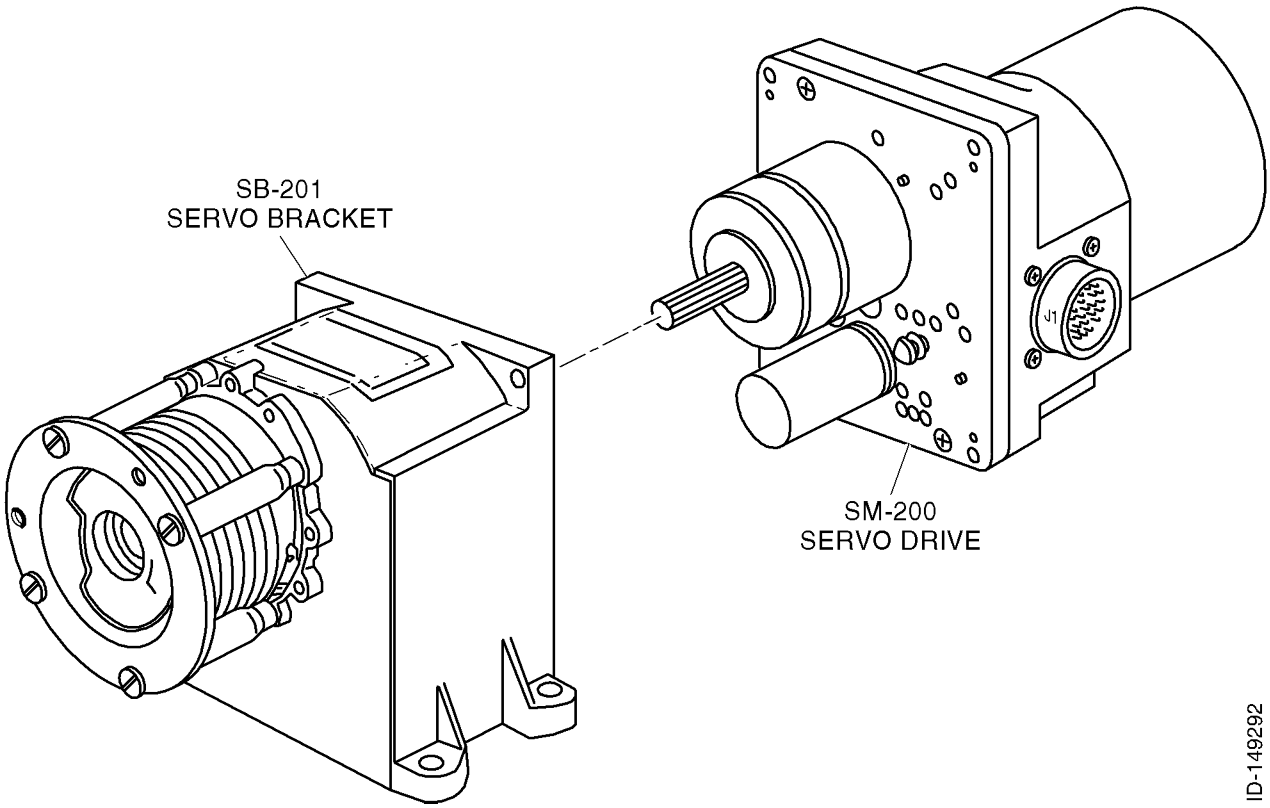

Figure 2-6-3. SM-200 Servo Drive and SB-201 Servo Bracket

Table 2-6-3. SM-200 Servo Drive and SB-201 Servo Bracket Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	3.970 in. (100.8 mm)
• Width	5.065 in. (128.8 mm)
• Length	8.825 in. (224.3 mm)
Weight (maximum)	5.6 lb (2.55 kg)
Power requirements:	
• Clutch	28 V dc, 19 W (max)
• Motor stall	28 V dc, 56 W
Stall torque	Up to 160 in-lb

Table 2-6-3. SM-200 Servo Drive and SB-201 Servo Bracket Leading Particulars (cont)

Item	Specification
Resistance values:	
• Clutch	57.5 ± 6 ohms
• Tachometer	140 ohms (max)
• Motor (see NOTE)	20.7 ± 2.6 ohms
User replaceable parts:	
• Drive to bracket retaining screws (4)	HPN 4011086
• Cable keepers (4)	HPN 2518330
• Retaining plate (1)	HPN 2518332
• Screw, cable capture	HPN 2554911-1
• Screw, plate retaining	HPN 0457-242
Mating connector J1	PT06E-14-19S(SR)
Mounting	Hard mount
NOTE: Motor resistance value is calculated by accurately measuring applied voltage and load current. When attempting to measure this resistance with an ohmmeter, the value may vary between 18 and several hundred ohms, depending upon brush position and the quantity of brush dust.	

(2) The SM-200 servo drive translates electrical inputs into clutched rotational mechanical outputs. Tachometer rate signals are fed back to the IC-615 IAC servo amplifier to null the command signal.

Table 2-6-4. SM-200 Servo Drive Dash Number Differences

Dash No.	Power Gear Ratio	Synchro Gear Ratio	Clutch Hi Pin	Clutch Lo Pin
-904	18.6:1	151.1:1	F	G
-906	38.9:1	151.1:1	F	J

3. Operation

A. General

(1) The PRIMUS 1000 autopilot/yaw damper interface is shown in Figure 2-6-4. This shows major signal flow between autopilot/yaw damper LRUs. For complete wiring interface data, refer to the AMM for the Cessna Citation XLS.

B. Modes of Operation

(1) The PRIMUS 1000 autopilot has five modes of operation as follows:

- Heading hold and wings level
- Roll hold
- Pitch attitude hold
- Flight director coupled
- Turn.

(2) Heading Hold and Wings Level

(a) Heading hold is defined as the basic lateral default autopilot mode, annunciated as ROL on the PFD. It is defined as follows:

- The autopilot is engaged.
- The bank angle is less than 6 degrees.
- No lateral flight director mode is active.

(b) When the conditions listed above are satisfied, the autopilot rolls the aircraft to a wings level attitude. When the aircraft's roll attitude is less than 3 degrees plus 3 seconds, the heading hold mode is automatically engaged. ROL annunciates on the master PFD.

(3) Roll Hold

(a) The roll hold mode is recognized as being active when the following conditions exist:

- The autopilot is engaged.
- No lateral flight director mode is active.
- The aircraft's bank angle is greater than 6 degrees but less than 34 degrees.
- TCS is used to initiate the roll maneuver.

(b) When all of the above conditions are satisfied, the autopilot maintains the prescribed bank angle. If TCS is released at bank angles greater than 34 degrees, the autopilot rolls the aircraft to 34 degrees and maintains the bank angle.

(c) If TCS is released at bank angles less than 6 degrees, the autopilot reverts to a wings level condition and then heading hold, which annunciates as ROL on the PFD.

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(d) Touch control steering lets the pilot momentarily disengage the autopilot and manually fly the aircraft to a new pitch/roll attitude reference. Touch control steering does not have any effect on the yaw damper.

(e) The TCS switches are located on the pilot's and copilot's control wheels. When either switch is activated and held, the following occurs:

- Autopilot clutches (aileron and elevator) disengage.
- Autopilot pitch axis memory synchronizes to current aircraft position. When the pilot completes the maneuver and releases the TCS switch, the autopilot clutch re-engages and the autopilot now holds the new pitch attitude reference. Depending upon the bank angle at TCS release, the autopilot goes into either wings level or roll hold mode, if no other flight director modes are active.

(4) Pitch Attitude Hold

(a) Pitch attitude hold is the basic vertical mode of the autopilot, which annunciates as PIT on the master PFD. It automatically becomes active when one of the following occurs:

- The autopilot is engaged.
- A lateral flight director mode is active and no vertical flight director mode is active.

(b) The position of the pitch command bar on the master PFD supplies the pilot with a reference of aircraft pitch attitude at the moment the autopilot is engaged. This pitch attitude reference can be changed as a function of TCS or use of the PITCH wheel on the PC-400 autopilot controller.

(c) Rotation of the PITCH wheel annunciates PIT on the master PFD and results in a change of pitch attitude proportional to the rotation of the wheel and in the direction of wheel movement. The PITCH wheel supplies rate-limited pitch commands in pitch hold mode. The PITCH wheel supplies a tachometer output that is applied to the pilot's IC-615 IAC. Pitch wheel operation is inhibited when flying a flight director coupled approach and the glideslope mode is in the capture or track phase of operation. PITCH wheel movement cancels the ALT hold and ASEL modes.

(d) While in pitch attitude hold, pushing and holding the TCS button on the control column disengages the elevator and aileron servo clutches, and synchronizes the autopilot pitch reference to existing aircraft pitch attitude. The pilot can manually fly the aircraft to a new pitch attitude reference, and the autopilot memory synchronizes to it. Releasing the TCS button re-engages the elevator and aileron servo clutches, and the pitch axis of the autopilot supplies stabilization around this new reference.

(5) Flight Director Couple and Lift Compensation

(a) With the autopilot engaged, anytime a flight director mode is selected on, the computed steering command (attitude change) is transmitted to the autopilot. The autopilot, in turn, develops a servo loop command to drive the appropriate flight control surface to satisfy the flight director input. This coupling of flight director and autopilot allows hands-off automatic flightpath steering throughout the aircraft's flight regime.

(b) Just as pilots are taught to keep the nose of the aircraft up when making a turn, the autopilot must have the same ability. When banking an aircraft to make a turn, lift is lost on one wing. This loss of lift results in the aircraft losing altitude. To compensate for this manually, the pilot applies a slight back pressure to the control column to hold the nose up and not lose altitude in the turn.

(c) The autopilot accomplishes this automatically through a design feature called lift compensation. This is done creating a term that is equal to the cosine of the bank angle subtracted from 1.0 and applying this term to the pitch axis of the autopilot. This in effect keeps the nose of the aircraft in the proper attitude to not lose altitude as the turn is made.

(6) Turn

(a) Rotation of the TURN knob out of its center detent position results in a roll command that annunciates ROL on the master PFD. The roll angle is proportional to and in the direction of TURN knob rotation. The TURN knob controls a detent switch and potentiometer to supply roll commands to the IC-615 IAC. The TURN knob must be in detent (center position) before the autopilot can be engaged. Rotation of the TURN knob out of detent cancels any lateral flight director mode that was active. Returning the TURN knob to its center detent position does not automatically re-engage flight director modes.

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NOTES:
1. All relays shown in unenergized position.
2. S4 and S5 must carry engage circuit currents as shown to maintain autopilot safety. The components must be rated to switch 28 V dc @ 3 amps inductive minimum.
3. WOW - both gears in parallel.

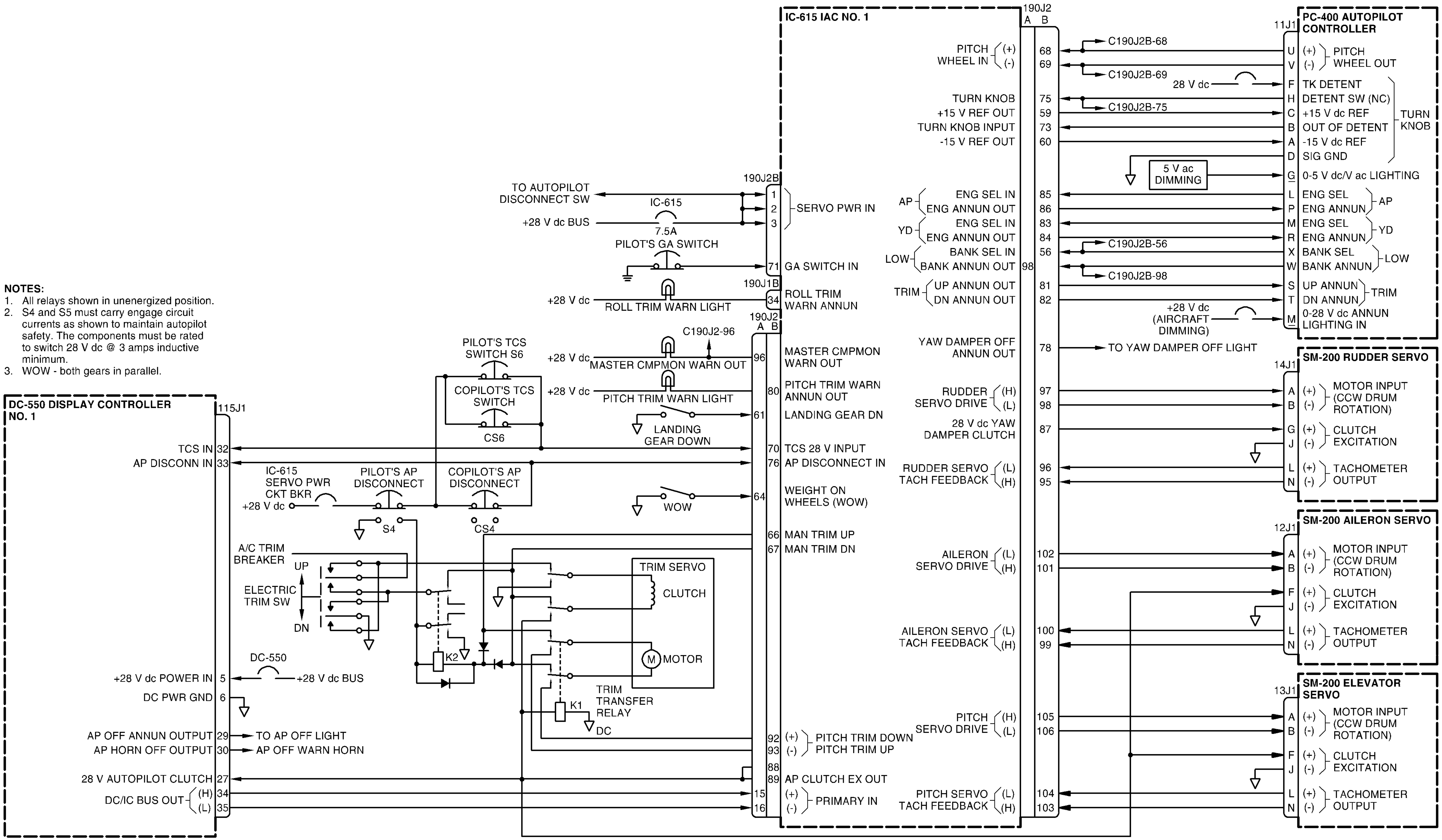

Figure 2-6-4 (Sheet 1). Autopilot/Yaw Damper Interface

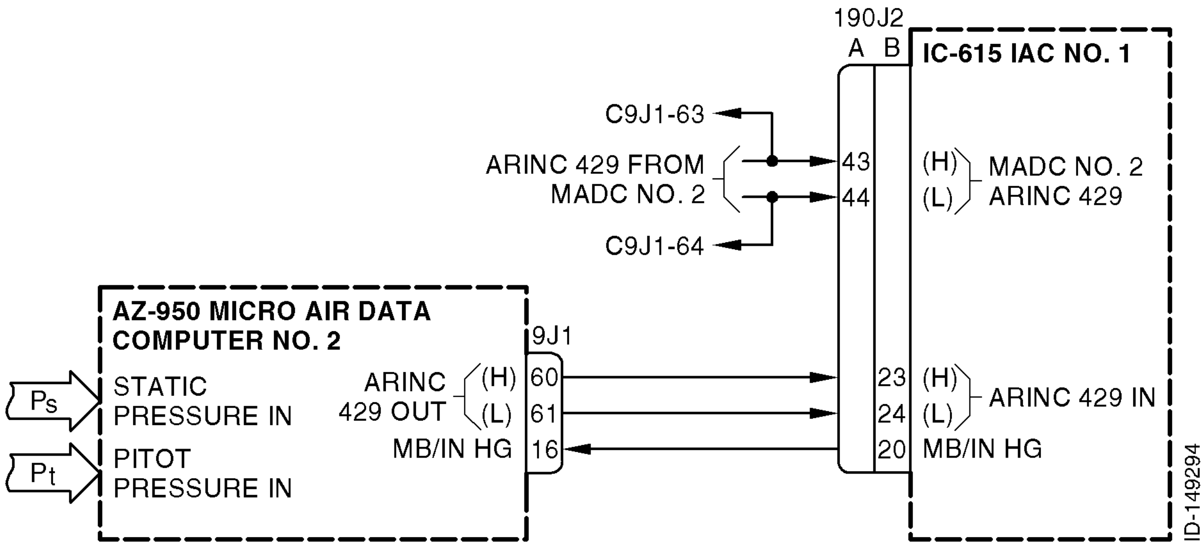

Figure 2-6-4 (Sheet 2). Autopilot/Yaw Damper Interface

C. Autopilot/Yaw Damper Engage Logic

(1) The PRIMUS 1000 autopilot/yaw damper is a fail-passive system. The autopilot/yaw damper is engaged when the AP switch is pushed and the autopilot/yaw damper engage valids and primary processor heartbeat enables are active. The autopilot/yaw damper engage and disengage logic is primarily a hardware function. The autopilot and primary processors cannot by themselves engage the autopilot or the yaw damper function. The processors instead provide engage enable logic discretes; the primary processor also provides a heartbeat enable signal. These discretes, along with the button on the autopilot controller, are inputs to the hardware logic circuitry, which determines whether or not the autopilot and/or yaw damper engages or disengages (see Figure 2-6-5). Autopilot/yaw damper annunciation is provided by illumination of the button on the autopilot controller.

(2) Autopilot and yaw damper engagement is controlled from the PC-400 autopilot controller. The AP quick disconnect switches, electric trim switch, and TCS switches, located on the control wheels, also affect autopilot engagement, as does the manual electric pitch trim switch.

(3) Yaw Damper Engagement

(a) Pushing the YD ENGAGE select switch engages the yaw damper when the yaw damper engage valid and the primary processor heartbeat enables are active. Pushing the YD ENGAGE select switch engages only the yaw damper. Pushing the YD ENGAGE select switch with the autopilot and/or the yaw damper engaged, disengages both. Engagement of the yaw damper is inhibited under any of the following conditions:

- The composite ARINC 429 data is invalid.
- The AHRS yaw rate data is invalid.
- The analog ground test failed.
- The continuous PROM checksum test failed.
- The continuous RAM test failed.
- One or more of the power-up tests failed.
- The autopilot processor self-test ticket checks failed.
- The continuous A/D wraparound test failed.
- The stack overflow test failed.
- The event table overflow test failed.
- The autopilot monitor software yaw damper ticket check value is invalid.

(4) Autopilot Engagement

(a) Pushing the AP ENGAGE select switch engages the autopilot and yaw damper if all engage logic is valid. Pushing the AP ENGAGE select switch, when the autopilot is engaged, disengages the autopilot only. The elevator trim servo is engaged when the autopilot is engaged. Engagement of the autopilot is inhibited under any of the following conditions:

- The composite ARINC 429 data is invalid.
- The AHRS yaw rate data is invalid.
- The analog ground test failed.
- The continuous PROM checksum test failed.
- The continuous RAM test failed.
- One or more of the power-up tests failed.
- The autopilot processor self-test ticket checks failed.
- The continuous A/D wraparound test failed.
- The stack overflow test failed.
- The event table overflow test failed.
- The autopilot monitor software autopilot ticket check value is invalid.
- The pitch/roll attitude reference data is invalid.
- The yaw damper engage valid is inactive.

(5) Yaw Damper Disengagement

(a) Pushing the AP ENGAGE select switch when the autopilot is engaged, disengages the autopilot only. Pushing the YD ENGAGE select switch with the autopilot and/or the yaw damper engaged, disengages both. The manual trim disengages the autopilot only and the yaw damper remains engaged. The elevator trim servo disengages when the autopilot is disengaged.

(b) Automatic disengagement of the yaw damper occurs under any of the following conditions:

- The composite ARINC 429 data is invalid.
- The AHRS yaw rate data is invalid.
- The analog ground test failed.
- The continuous PROM checksum test failed.
- The continuous RAM test failed.
- The autopilot processor self-test ticket checks failed.
- The continuous A/D wraparound test failed.
- The stack overflow test failed.
- The event table overflow test failed.
- The autopilot monitor software yaw damper ticket check value is invalid.
- The primary processor heartbeat monitor and/or yaw damper engage valid enable is invalid.

(6) Autopilot Disengagement

(a) Pushing the AP ENGAGE select switch when the autopilot is engaged, disengages the autopilot only. Pushing the YD ENGAGE select switch with the autopilot and/or the yaw damper engaged, disengages both. The manual trim disengages the autopilot only and the yaw damper remains engaged. The elevator trim servo disengages when the autopilot is disengaged.

(b) Disengagement of the autopilot occurs under any of the following conditions:

- The composite ARINC 429 data is invalid.
- The AHRS yaw rate data is invalid.
- The analog ground test failed.
- The continuous PROM checksum test failed.
- The continuous RAM test failed.
- The autopilot processor self-test ticket checks failed.
- The continuous A/D wraparound test failed.
- The stack overflow test failed.
- The event table overflow test failed.
- The autopilot monitor software autopilot ticket check value is invalid.
- The pitch/roll attitude reference data is invalid.
- The yaw damper engage valid is inactive.
- The primary processor heartbeat monitor and/or autopilot engage valid enable is invalid.

(7) Servo Amplifier/Drive Enable Logic

(a) The primary processor (Figure 2-6-6) provides two discrete outputs that enable the aileron, elevator, rudder, and trim servo amplifiers. These are the autopilot servo amplifier enable and the yaw damper servo amplifier enable. If the autopilot servo amplifier enable is inactive, the servo amplifiers for the elevator, aileron, and elevator trim are disabled. If the yaw damper servo amplifier enable is inactive, the rudder servo amplifier is disabled. The final stage servo amplifier drivers are enabled when the previous conditions are met and the primary processor heartbeat enable and the power supply monitor enable are active. If either the primary processor heartbeat enable or the power supply monitor enable are are latched into a failed state, the servo amplifier drivers are set to a tristate (disabled) condition. The autopilot processor also provides a secondary method of disabling the servo amplifiers when under normal disengage circumstances. It forces the servo amplifier duty cycle commands to zero.

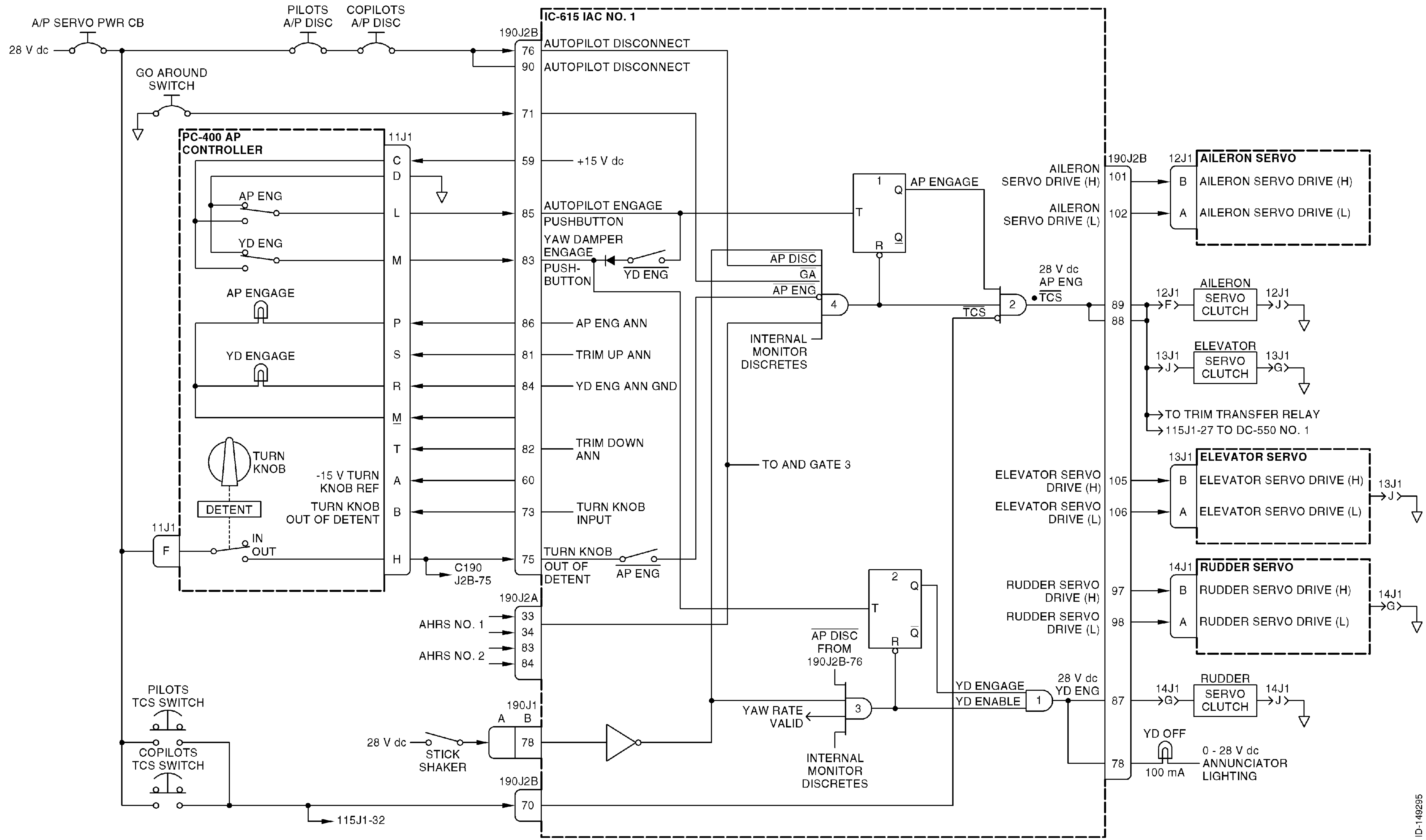

Figure 2-6-5. Autopilot/Yaw Damper Engage/Disengage Logic

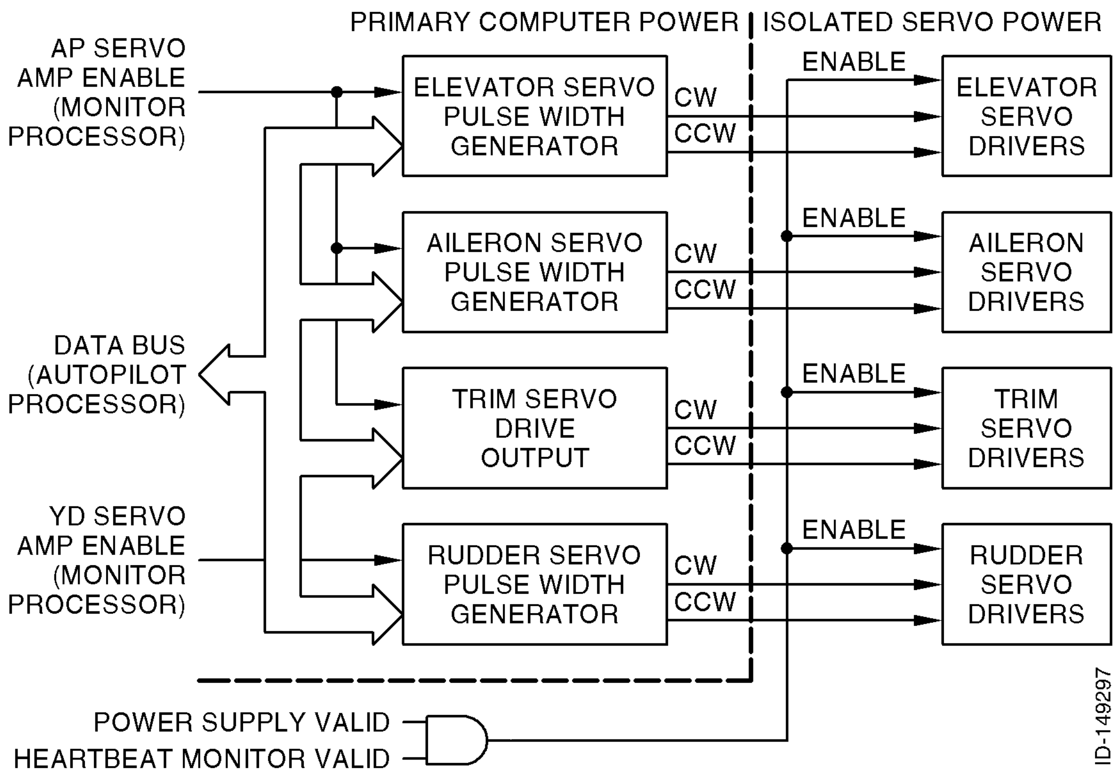

Figure 2-6-6. Servo Amplifier Drive Enable

D. Roll Axis Autopilot Servo Loop

(1) The autopilot roll axis servo loop (refer to Table 2-6-5 and Figure 2-6-7) is the same for all lateral steering modes. Since there is only one autopilot system and one servo in the roll axis, it does not matter if the steering command is heading select or localizer; the path to the servo is the same. The autopilot control loop is connected in parallel to the aircraft's primary control rigging through cables.

(2) The roll axis servo receives a drive signal from the IC-615 IAC that is the autopilot command to drive the ailerons. As the servo motor drives, it in turn moves the control rigging, which in turn moves the ailerons. As the ailerons move, a feedback signal from the servo is fed back to the IC-615 IAC and represents aircraft response to the autopilot command. When response equals command, the aileron drive signal goes to zero. When the autopilot command is satisfied, it goes to zero and the feedback signal drives the ailerons back to its original position.

(3) SM-200 Aileron Servo Drive and Bracket

(a) The SM-200 aileron servo translates electrical input signals into a clutched mechanical output. The output is used to drive the ailerons in response to roll axis autopilot commands. A description of servo functions follows.

(b) Servo Clutch

1 The servo clutch is engaged as a function of autopilot engagement, or release of TCS if the autopilot was previously engaged. The clutch disengages anytime the autopilot is disconnected or the TCS switch is pushed and held with the autopilot previously engaged.

(c) Servo Torque Motor

1 The servo torque motor receives direct current from the IC-615 IAC pitch axis. With the servo clutch engaged, the torque motor output drives a power gear train through mechanical coupling. The gear train output, in turn, supplies the drive that moves the ailerons to the desired position. With the autopilot not engaged, any input drive to the servo motor is not coupled to the ailerons.

(d) DC Tach Generator

1 The DC tach generator is mechanically connected to the servo torque motor and supplies an output back to the IC-615 IAC anytime the servo torque motor drives, which represents the rate at which the ailerons are being moved. The DC tach generator supplies the following two functions:

- The DC tach supplies an aileron rate of travel signal to the IC-615 IAC, which is used as a damping term. When the ailerons are commanded to a position, they should move to that position smoothly and stop still, not move or hunt about that position.
- In the IC-615 IAC, the DC tach generator signal is also integrated to derive aileron position feedback. This signal is used to ensure that the aileron torque motor has driven the ailerons as commanded.

(4) IC-615 IAC

(a) The IC-615 IAC receives sensor data and command inputs, and processes this data in accordance with any lateral steering mode that is active. Since this is a digital computer, this processing is accomplished through software. To supply a current to drive the servo torque motor, this digitally processed signal must be changed into analog form.

(b) Additionally, to ensure safe operation, certain functions and values of certain parameters are monitored in the IC-615 IAC to ensure the autopilot is automatically disconnected if a safety critical malfunction occurs. A description of the IC-615 roll axis autopilot servo drive follows.

(c) Roll Axis Attitude Loop

1 The roll axis attitude loop processes the autopilot command, roll attitude, and derived roll rate of change to establish the aileron servo drive command. Both roll attitude and derived roll rate terms are gain programmed as a function of IAS.

2 The flight director roll command is limited by the autopilot to ±35 degrees of bank and rate of change to 7 degrees per second. The rate limited roll attitude reference command is used as an input to the aileron servo loop.

(d) Aileron Servo Loop

1 The aileron servo loop uses the roll attitude loop command to compute an aileron servo pulse width command with the autopilot engaged. If the autopilot is not engaged, the aileron servo pulse width is zero.

2 Aileron servo position is derived by integrating the aileron servo DC tach generator feedback signal. The DC tach generator signal is also used as a damping term in positioning the ailerons. Aileron servo current is passed through a current limiter and servo driver before being sent to the servo amplifier.

(e) Current Limiter

1 Current limiting is performed on the servo command signal to ensure that the proper servo drive values are established.

(f) Servo Amplifier

1 The servo amplifier acts as a switch that supplies drive current to the aileron servo torque motor. A servo enable discrete is applied as a function of autopilot engagement. The servo requires 1-ampere current drive capability. The servo amplifier supplies a 480-Hz pulse-width modulated, 28-volt bipolar output. The pulse-width command output is compared with a 480-Hz sawtooth signal to generate the pulse width control for the servo driver. The servo loop software executes at 240 Hz so that the servo amplifier output is the same for two complete duty cycles.

2 The primary processor supplies a discrete output that enables the aileron servo amplifier. If this discrete is not available, the servo amplifier is forced to a zero duty cycle. A latched heartbeat monitor and a latched power supply monitor (both not shown) are required to enable the servo amplifier driver.

3 For the primary processor servo amplifier enable to be active, the following are required:

- Autopilot servo amplifier enable (monitor processor)
- Data bus (autopilot processor)
- Yaw damper amplifier enable (monitor processor)
- Power supply valid
- Heartbeat monitor valid.

Table 2-6-5. Autopilot Roll Axis Operating Limits

Mode	Parameter	Value
Autopilot engage	Engage limit	Roll: Up to ±35° Pitch: Up to ±20°
Yaw damper engage	Engage limit	Up to 45° left or right bank
Touch control steering	Roll control limit Pitch control limit	Up to ±35° Up to ±25°
TURN knob	Roll angle limit Roll rate limit	±30° 3°/sec
PITCH wheel	Pitch angle limit Normal acceleration limit	±20° pitch 0.3 g
Heading hold	Roll angle limit Roll rate limit	±30° 5.5 °/sec

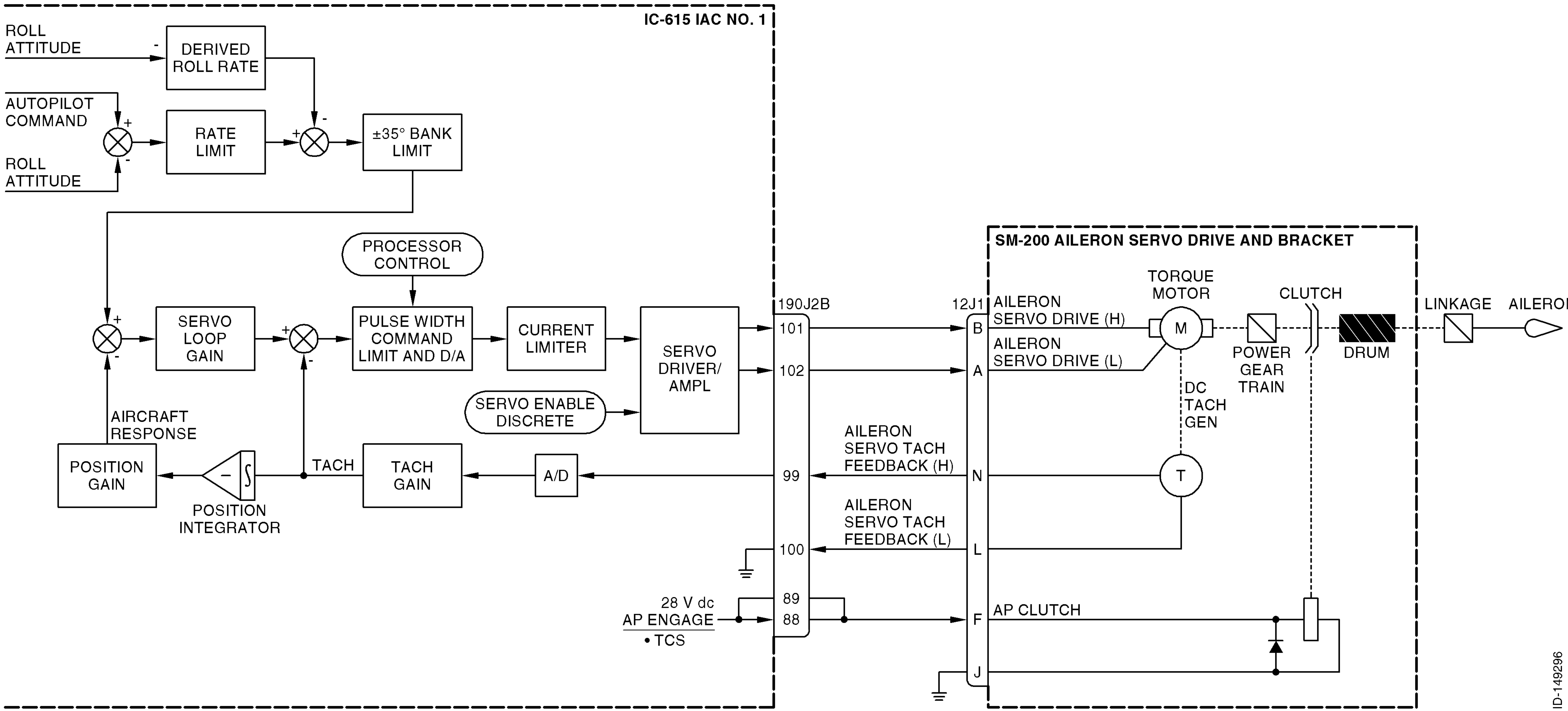

Figure 2-6-7. Autopilot Roll Axis Servo Loop

E. Pitch Axis Autopilot Servo Loop

(1) The pitch autopilot servo loop (refer to Table 2-6-6 and Figure 2-6-8) is the same for all vertical steering modes. Since there is only one autopilot system and one servo in the pitch axis, it does not matter if the steering command is altitude hold or vertical speed hold, the path to the servo is the same. The autopilot servo loop is connected in parallel to the aircraft's primary control rigging through cables.

(2) The pitch axis servo receives a drive signal from the IC-615 IAC, which is the autopilot's command to drive the elevator. As the servo motor drives, it moves the control rigging, which in turn moves the elevator. As the elevator moves, a feedback signal from the servo is sent to the IC-615 IAC and represents aircraft response to the autopilot command. When response equals command, the elevator drive signal goes to zero. When the autopilot command is satisfied, it goes to zero and the feedback signal drives the elevator back to its starting position.

(3) SM-200 Elevator Servo Drive and Bracket

(a) The SM-200 elevator servo drive and bracket translates electrical input signals into a clutched mechanical output. This output is used to drive the elevator in response to pitch axis autopilot commands. A description of servo functions follows.

(b) Servo Clutch

1 The servo clutch is engaged as a function of autopilot engagement, or release of TCS if the autopilot was previously engaged. The clutch disengages anytime the autopilot is disconnected or the TCS switch is pushed and held.

(c) Servo Torque Motor

1 The servo torque motor receives DC current from the IC-615 IAC pitch axis. With the servo clutch engaged, the torque motor output drives a power gear train through mechanical coupling. The gear train output supplies the drive to move the elevator to the desired position. With the autopilot not engaged, any input drive to the servo motor is not coupled to the elevator.

(d) DC Tach Generator

1 The DC tach generator is mechanically connected to the servo torque motor and supplies an output back to the IC-615 IAC anytime the servo torque motor drives, which represents the rate at which the elevator is being moved. The DC tach generator supplies the following two functions:

- DC tach supplies an elevator rate of travel signal to the IC-615 IAC. This signal is used as a damping term. When the elevator is commanded to a position, it should move to that position smoothly and stop still, not move or hunt about that position.
- In the IC-615 IAC, the DC tach generator signal is also integrated to derive elevator position feedback. This signal is used to ensure that the elevator torque motor has driven the elevator as properly commanded.

(4) IC-615 IAC

(a) The IC-615 IAC receives sensor data and command inputs, and processes this data in accordance with any vertical steering mode that is active. Since this is a digital computer, this processing is accomplished through software. To supply a current to drive the servo torque motor, this digitally processed signal must be changed into analog form.

(b) Additionally, to ensure safe operation, certain functions and values of certain parameters are monitored in the IC-615 IAC to ensure that the autopilot is automatically disconnected if a safety critical malfunction occurs. A description of the IC-615 pitch axis autopilot servo drive follows.

(c) Pitch Axis Attitude Loop

1 The pitch axis attitude loop processes the autopilot command, pitch attitude, and derived pitch rate of change to establish the elevator servo drive command. Both pitch attitude and derived pitch rate terms are gain programmed as a function of IAS.

2 The flight director pitch command is limited by the autopilot to ±20 degrees and rate of change is a variable as a function of airspeed. The rate limited pitch attitude reference command is used as an input to the elevator servo loop.

(d) Elevator Servo Loop

1 The elevator servo loop uses the pitch attitude loop command to compute an elevator servo pulse width command with the autopilot engaged. If the autopilot is not engaged, the elevator servo pulse width is zero.

2 Elevator servo position is derived by integrating the elevator servo DC tach generator feedback signal. The DC tach generator signal is also used as a damping term in positioning the elevator. Elevator servo current is passed through a current limiter and servo driver before being sent to the servo amplifier.

(e) Current Limiter

1 Current limiting is performed on the servo command signal to ensure that the proper servo drive values are established.

(f) Servo Amplifier

1 The servo amplifier acts as a switch to supply drive current to the elevator servo torque motor. A servo enable discrete is applied as a function of autopilot engagement. The servo requires 1-ampere current drive capability. The servo amplifier supplies a 480-Hz pulse-width-modulated, 28-volt bipolar output. The pulse-width command output is compared with a 480-Hz sawtooth signal to generate the pulse width control for the servo driver. The servo loop software executes at 240 Hz so the servo amplifier output is the same for two complete duty cycles.

2 The primary processor supplies a discrete output that enables the aileron servo amplifier. If this discrete is not available, the servo amplifier is forced to a zero duty cycle. A latched heartbeat monitor and a latched power supply monitor (both not shown) are required to enable the servo amplifier driver.

3 For the primary processor servo amplifier enable to be active, the following are required:

- Autopilot servo amplifier enable (monitor processor)
- Data bus (autopilot processor)
- Yaw damper amplifier enable (monitor processor)
- Power supply valid
- Heartbeat monitor valid.

F. Pitch Axis Autopilot Trim

(1) The autopilot processor performs elevator trim control based on elevator servo current demand. Elevator trim engagement is controlled by the autopilot engage logic, and the trim clutch is wired to the same clutch output as the aileron and elevator servo clutches.

(2) The trim motor is driven in a manner to move the elevator trim tab to reduce the air load on the elevator servo. The trim drive is a 0.625-Hz pulse-width modulated, 28 V dc output. The pulse width is controlled as a function of airspeed.

(3) Elevator trim rate is programmed with TAS to supply variable trim rate based on flight conditions. The use of TAS for gain programming allows the long-term elevator response (trim rate) to decrease with increasing altitude.

(4) When elevator servo current exceeds a predetermined threshold for a given period of time, this is considered a steady-state error and trim runs. Out of the up/down sensor is a positive or negative current. This arms one input to an AND gate. The trim drive is also applied to a time delay and after the time delay is met, an output is applied to both AND gates. One AND gate is turned on and lets the trim motor run. As the trim motor runs, the trim tab is positioned to aerodynamically hold the elevator in position, and the elevator is repositioned to reduce the electrical load on the servo. When this load falls below the threshold level, trim stops running.

(5) When the up/down sensor allows an output, an internal clock runs for 10 seconds. If a trim malfunction has occurred and the trim system has not sufficiently reduced elevator servo current, the other trim threshold sensor lets an output annunciate an out-of-trim condition on the PC-400 autopilot controller. This annunciator informs the pilot that the aircraft is out of trim.

(6) To manually trim the aircraft, the pilot takes control of the aircraft, disengages the autopilot, and retrims the aircraft.

Table 2-6-6. Pitch Channel Axis Operating Limits

Mode	Parameter	Value
AP	Pitch limit	$\pm 20°$
TCS	Pitch control limit	Up to $\pm 25°$

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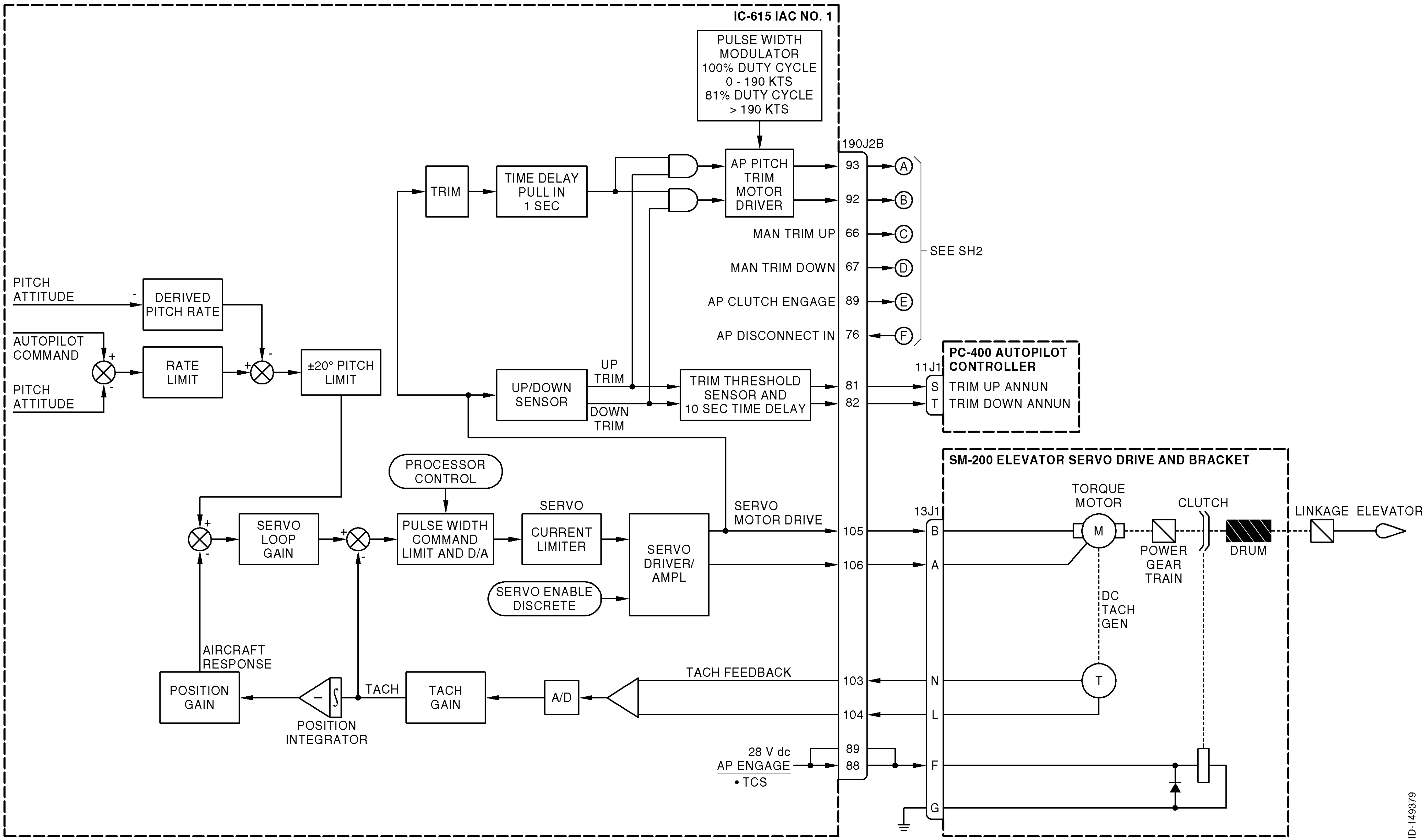
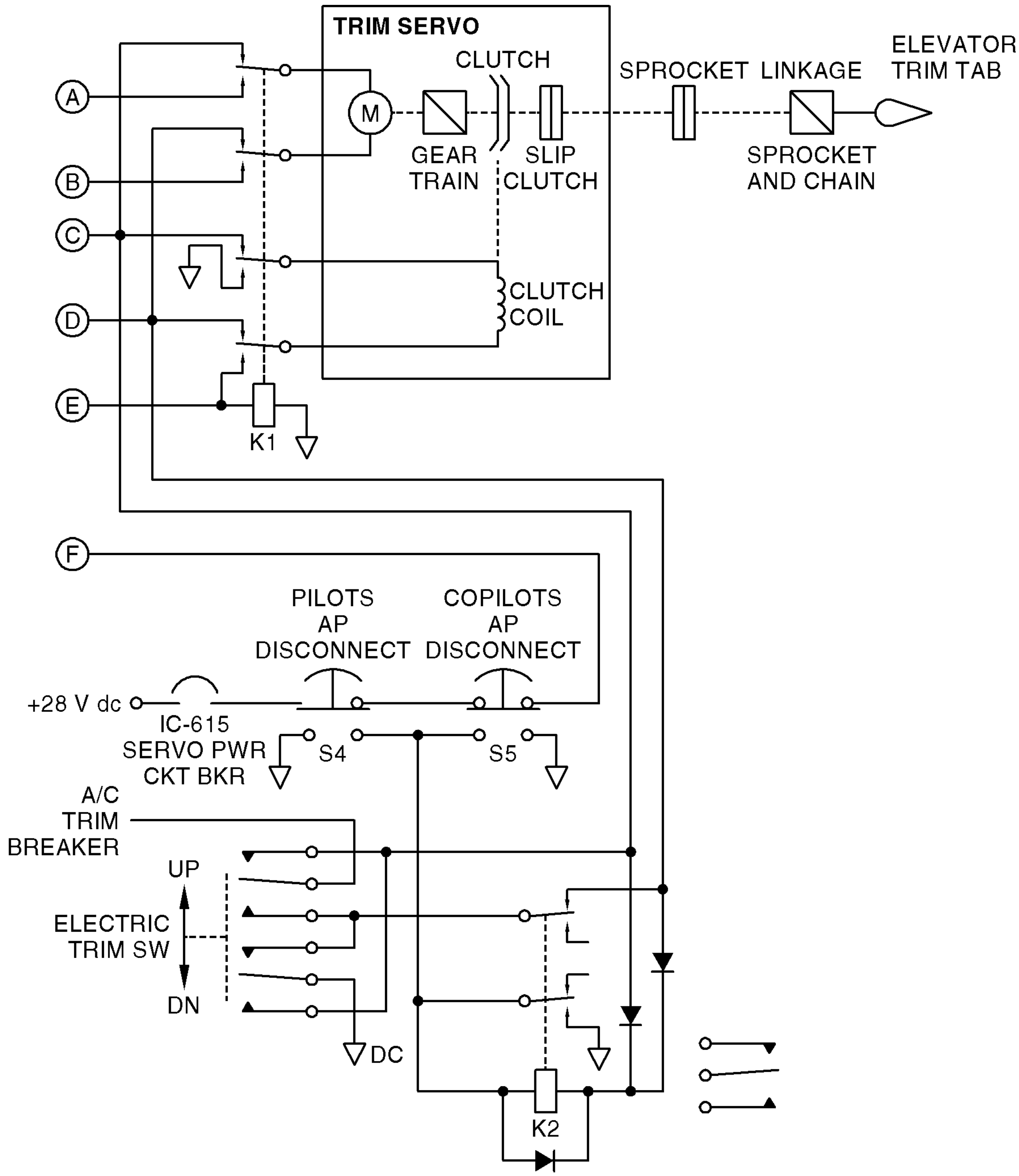


Figure 2-6-8 (Sheet 1). Autopilot Pitch Axis Servo Loop



NOTES:
1. All relays shown in de-energized position.
2. S4 and S5 must carry engage circuit currents as shown to maintain autopilot safety. The components must be rated to switch 28 V dc at 3 amps inductive minimum.

Figure 2-6-8 (Sheet 2). Autopilot Pitch Axis Servo Loop

G. Rudder Axis Yaw Damper Servo Loop

(1) The yaw damper servo loop (see Figure 2-6-9) is independent from the autopilot in that it can be engaged without the autopilot being engaged. The yaw damper does not receive any commands from the flight director. The yaw damper supplies the following two functions in the aircraft:

- Yaw damping for transient wind gusts
- Turn coordination with the roll axis of the autopilot.

(2) The rudder axis servo is connected in parallel with the aircraft's primary rigging through cables. The rudder axis servo receives a drive signal from the IC-615 IAC, which is the yaw damper command to drive the rudder. As the servo motor drives, it moves the control rigging, which in turn moves the rudder. As the rudder moves, a feedback signal from the servo is sent to the IC-615 IAC and represents aircraft response to the yaw damper command. When the response equals command, the rudder drive signal goes to zero. When the yaw damper command is satisfied, it goes to zero and the feedback signal drives the rudder back to its starting position.

(3) IC-615 IAC

(a) The IC-615 IAC receives sensor data and command inputs, and processes this data. Since this is a digital computer, this processing is accomplished through software. To supply a current to drive the servo torque motor, this digitally processed signal is changed into analog form.

(b) Additionally, to ensure safe operation, certain functions and values of certain parameters are monitored in the IC-615 IAC to ensure that the yaw damper is automatically disconnected if a safety-critical malfunction occurs. A description of the IC-615 IAC rudder axis yaw damper servo drive follows.

(c) Yaw Axis Attitude Rate Loop

1 Actual aircraft yaw rate and actual aircraft roll attitude from the AHRS are summed to generate a computed yaw term to drive the rudder. Roll attitude is TAS programmed to achieve the proper signal gain as altitude and airspeed change.

(d) Rudder Servo Loop

1 The rudder servo loop uses the computed yaw attitude rate loop command to compute a rudder servo pulse width command with the yaw damper engaged. If the yaw damper is not engaged, the rudder servo pulse width is zero.

2 Rudder servo position is derived by integrating the rudder servo DC tach generator feedback signal. The DC tach generator signal is also used as a damping term in positioning the rudder. Rudder servo current is passed through a current limiter and servo driver before sending to the servo amplifier.

(e) Current Limiter

1 Current limiting is performed on the servo command signal to ensure that the proper servo drive values are established.

(f) Servo Amplifier

1 The servo amplifier acts as a switch to supply drive current to the servo torque motor. Servo enable is applied as a function of yaw damper engagement. The servo requires 1-ampere current drive capability. The servo amplifier supplies a 480-Hz pulse-width modulated, 28-volt bipolar output. The pulse-width command output is compared with a 480-Hz sawtooth signal to generate the pulse width control for the servo driver. The servo loop software executes at 240 Hz so that the servo amplifier output is the same for two complete duty cycles.

(g) Rudder Washout

1 The yaw damper is primarily responsive to short-term rate signals. Since the servo loop is an electrical-mechanical operating system, it is possible that the yaw rate attitude loop command and servo feedback signals do not exactly cancel. To eliminate this standoff condition, any long-term output of the servo amplifier is fed to the rudder washout integrator. The output of the integrator is inverted and sent back into the servo loop to eliminate the standoff condition.

2 Rudder washout also lets the pilot manually retrim the rudder with the yaw damper engaged.

(h) Tach Integrator

1 Position feedback is achieved by taking the rudder servo tachometer signal, which is a rate of travel term, and integrating it. Integrating rate of travel over time derives distance travelled, or position.

(4) SM-200 Servo Drive and Bracket

(a) The SM-200 translates electrical input signals into a clutched mechanical output. This output is used to drive the rudder in response to yaw axis commands. A description of servo functions follows.

(b) Servo Clutch

1 The servo clutch is engaged as a function of autopilot or yaw damper engagement. The clutch disengages anytime the yaw damper is disconnected.

(c) Servo Torque Motor

1 The servo torque motor receives direct current from the IC-615 IAC yaw axis. With the servo clutch engaged, the torque motor output drives a power gear train through mechanical coupling. The gear train output in turn supplies the drive to move the rudder to the desired position. With the yaw damper not engaged, any input drive to the servo motor is not coupled to the rudder.

(d) DC Tach Generator

1 The DC tach generator is mechanically connected to the servo torque motor and supplies an output back to the IC-615 IAC anytime the servo torque motor drives. The DC tach generator supplies the following two functions:

- DC tach supplies a rate of travel feedback signal to the IC-615 IAC. This signal is used as a damping term. When the rudder is commanded to a position, it should move to that position smoothly and stop still, not move or hunt about that position.
- In the IC-615 IAC, the DC tach generator signal is also integrated to derive rudder position feedback. This signal is used to ensure that the rudder torque motor has driven the rudder as properly commanded.

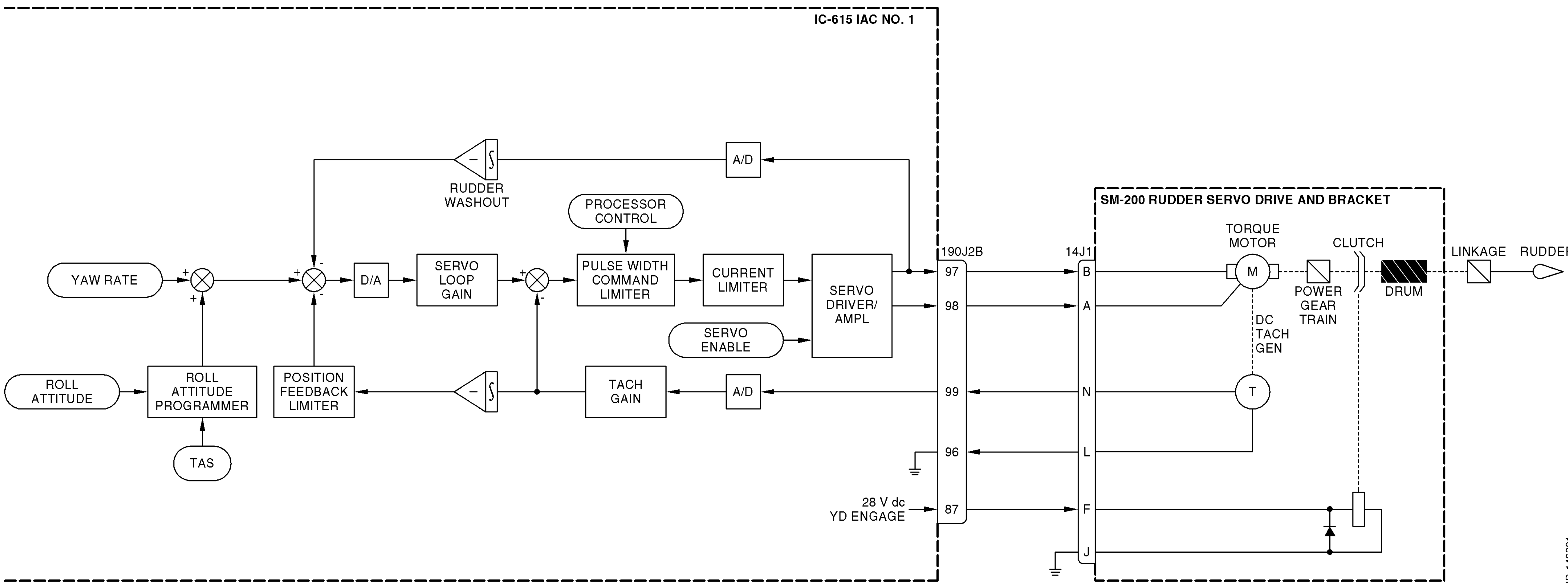


Figure 2-6-9. Autopilot Yaw Damper Servo Loop

4. Fault Monitoring

A. Autopilot/Yaw Damper Monitoring Overview

(1) The autopilot/yaw damper monitoring function is supplied by the IC-615 IAC primary processor. The primary processor uses independent hardware for sensor input and servo feedback data used by the monitoring function. This separation ensures that hardware failures do not affect the autopilot control function.

(2) The primary processor supplies dedicated disconnect hardware for the monitoring function. This gives the monitors the capability to disengage the autopilot and yaw damper independent of the autopilot processor hardware. All automatic disconnects that result from monitor trips store an event code in nonvolatile memory for subsequent recall during ground maintenance testing (WOW).

(3) The disengage path is tested during autopilot power-up to ensure that latent failures do not inhibit monitor operation. The servo amplifier disable path (heartbeat monitor, power supply monitor, monitor processor valid) are all individually tested at power-up. These tests consist of driving the pitch, roll, and yaw servos; and validating proper tachometer feedback and current sensing.

(4) The monitors use computed TAS and IAS to model gain programmers and the pitch g limit. If the air data is not valid, the following default values are used:

- TAS = 300 kt
- IAS = 220 kt.

B. Hardover/Slowover Malfunction Protection

(1) The distributed processor architecture of the PRIMUS 1000 system is designed to prevent hazards, such as autopilot hardovers. This protection ensures that failures in either processor are defeated or minimized by the monitors and/or limiters in the other processor. In general, failures of the primary processor (flight director) do not result in an abrupt aircraft response because the attitude command path is limited to a normal control response envelope in the secondary processor (autopilot). This is insured by a ±25 degree magnitude limit and a ±0.3g rate limit in the pitch axis, and a ±35 degree magnitude limit and a ±7 degrees per second rate limit in the roll axis in the autopilot processor. Failures of the autopilot processor are detected by the monitors in the primary processor and result in an autopilot/yaw damper disconnect, well in advance of exceeding autopilot hazard criteria.

(2) The pitch and roll attitude command magnitude limits also supply secondary slowover protection. Primary protection is dependent on pilot recognition. During CAT 2 approaches, an excessive deviation monitor also supplies slow-over protection.

C. System Response to Failures

(1) In the event of an autopilot processor fault, the monitor disconnects the autopilot prior to any significant aircraft response. Upon monitor disconnect, a red AP OFF is displayed on the master PFD.

D. Monitor Description

(1) Pitch Servo Position Monitor

(a) The pitch servo position monitor models the pitch attitude loop and servo loop, and generates a predicted elevator servo position. The predicted servo position is compared against actual position feedback. The actual servo feedback is generated by lagging the servo tachometer feedback in the monitor process. The monitor trip level is programmed with IAS to allow a somewhat uniform aircraft response exposure. Any failure that results in exceeding the monitor trip level for a period of 0.26 seconds results in an automatic disconnect of the autopilot and yaw damper.

(2) Primary Pitch Attitude Comparison

(a) The primary pitch attitude comparison monitor compares the onside primary pitch attitude used in the primary processor with the pitch attitude used in the secondary processor. This monitor validates the hardware path between processors and ensures that the pitch attitude computations of both processors agree.

(b) A trip of the pitch comparator monitor prevents autopilot/yaw damper engagement and causes a latched disengage, if the autopilot/yaw damper were engaged at the time of the monitor trip.

(c) If the pitch comparator exceeds a 3-degree threshold for 0.5 seconds, the monitor trips.

(3) Secondary Pitch Attitude Comparison Monitor

(a) The secondary pitch attitude comparison monitor compares the onside primary pitch attitude with the onside secondary pitch attitude. This monitor validates the attitude source used by the pitch servo position monitor.

(4) Normal Acceleration Monitor

(a) The normal acceleration monitor disconnects the autopilot if the Earth-based normal acceleration component of the onside primary AHRS acceleration data exceeds 0.6 g for greater than 0.4 seconds. The normal acceleration monitor is made up of three primary functional components. The first component converts the AHRS-based body accelerations to an Earth-based reference. The normal component of the Earth-based accelerations is used to determine monitor compliance. The second component determines whether or not the acceleration exceeds the defined threshold for the required time duration. The third component disconnects the autopilot.

(5) Roll Servo Position Monitor

(a) The roll servo position monitor models the roll attitude loop and servo loop, and generates a predicted aileron servo position. The predicted servo position is compared against actual position feedback. The actual servo feedback is generated by lagging the servo tachometer feedback in the monitor process. The monitor trip level is programmed with IAS, allowing a somewhat uniform aircraft response exposure. Any failure that results in exceeding the monitor trip level for a period of 0.26 seconds results in an automatic disconnect of the autopilot and yaw damper.

(6) Primary Roll Attitude Comparison Monitor

(a) The primary roll attitude comparison monitor compares the onside primary roll attitude used in the primary processor with the roll attitude used in the secondary processor. This monitor validates the hardware path between processors and ensures that the roll attitude computations of both processors agree.

(b) A trip of the roll comparator monitor prevents autopilot and yaw damper engagement, and causes a latched disengage if the autopilot/yaw damper were engaged at the time of the monitor trip.

(c) If the roll comparator exceeds a 3-degree threshold for 0.5 seconds, the monitor trips.

(7) Secondary Roll Attitude Comparison Monitor

(a) The secondary roll attitude comparison monitor compares the onside primary roll attitude with the onside secondary roll attitude. This monitor validates the attitude source used by the roll servo position monitor.

(8) Roll Rate Monitor

(a) The roll rate monitor supplies an additional means of detecting autopilot malfunctions. The monitor disconnects the autopilot and yaw damper, if actual roll rate exceeds 12 degrees per second for more than 0.5 seconds.

(9) Yaw Servo Position Monitor

(a) The yaw servo position monitor models the yaw rate loop and servo loop and generates a predicted elevator servo position. The predicted servo position is compared against actual position feedback. The actual servo feedback is generated by lagging the servo tachometer feedback in the monitor process. The monitor trip level is programmed with IAS, allowing a somewhat uniform aircraft response exposure. Any failure that results in exceeding the monitor trip level for a period of 0.6 seconds results in an automatic disconnect of the autopilot and yaw damper.

(10) Auto Trim Runaway Monitor

(a) The auto trim runaway monitor detects any condition that results in the autopilot processor commanding trim while the elevator servo current does not indicate a need for trim. The auto trim runaway monitor disconnects the autopilot and yaw damper immediately upon detecting a trim runaway condition.

(11) Auto Trim Inoperative Monitor

(a) The trim inoperative monitor provides a warn annunciator in view of the pilot (CAS message), indicating that the elevator is not properly trimmed. This monitor does not disconnect the autopilot.

(12) Autopilot/Yaw Damper Disconnect Monitor

(a) The autopilot and yaw damper disconnect monitor detect a failure of the system to disengage the autopilot and yaw damper in response to the autopilot disconnect switch being pushed. This monitor ensures that the disconnect discrete and autopilot and yaw damper engage status are valid. If self-engagement is detected within 0.6 seconds of a disconnect, the processor outputs an invalid state on the servo amplifier drive enable. This action prevents the IAC from applying any torque to the autopilot and yaw damper servos.

SECTION 2-7
ENHANCED GROUND PROXIMITY WARNING SYSTEM

1. Overview

A. General

(1) The purpose of the EGPWS is to prevent accidents caused by CFIT or severe windshear. The EGPWS computer receives various aircraft parameters and provides warning annunciations on the PFD and mode annunciations and graphical terrain data on the MFD. The system receives inputs from the following Honeywell LRUs:

- Navigation computer (FMS) that is part of the IC-615 IAC
- RT-300 radio altimeter receiver transmitter
- AHRS
- AZ-950 MADC.

2. Component Description and Location

A. EGPWS Computer

(1) The EGPWS computer is located in the nose compartment of the aircraft. Figure 2-7-1 shows a graphical view of the EGPWS computer. Table 2-7-1 gives items and specifications particular to the EGPWS computer.

Figure 2-7-1. EGPWS Computer

Table 2-7-1. EGPWS Computer Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	7.88 in. (200.15 mm)
• Width	2.43 in. (61.72 mm)
• Length	14.26 in. (362.21 mm)
Weight (maximum)	7.0 lb (3.18 kg)
Power requirements:	
• Voltage	28 V dc
• Power	22 W; 48 W (typical) with heater on
User replaceable parts	None
Mating connector	ITT Cannon Part No. BKAD1-125-30008-0F
Mounting tray	Barry Controls Part No. 602S0-C201

3. Operation

A. System Operation

(1) The system accepts a variety of aircraft parameters as inputs, applying alerting algorithms, and providing the flightcrew with aural alert messages and visual annunciations and displays in the event that the boundaries of any alerting envelope are exceeded. See Figure 2-7-2 for an overall system block diagram.

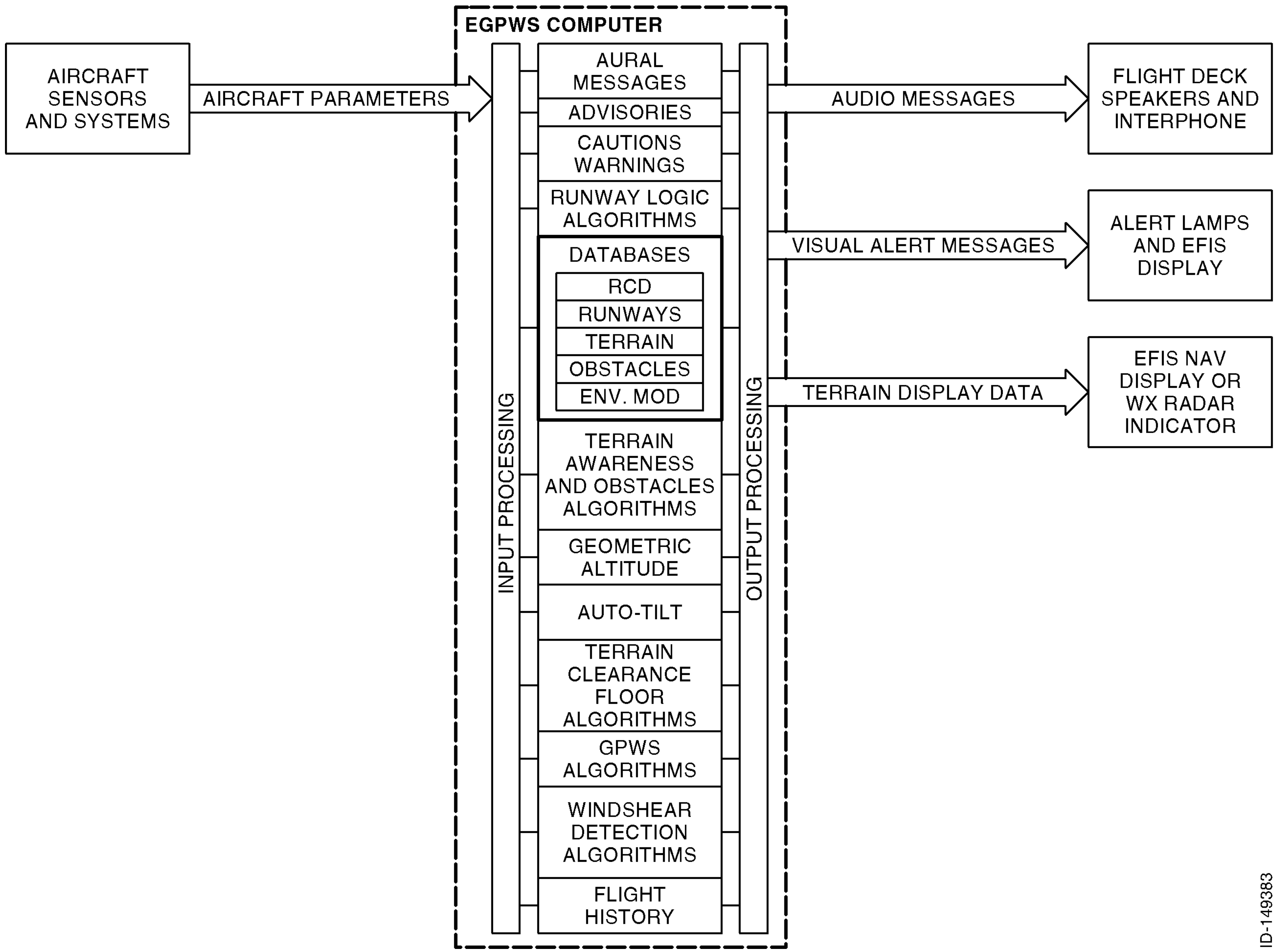


Figure 2-7-2. EGPWS Block Diagram

(2) The basic ground proximity warning function is the main part of the system, and its integrity is kept independent of the other functions. For example, loss of the terrain awareness display function will not affect the operation of the ground proximity warning functions (provided that the input signals necessary for ground proximity warning operation are still available). In addition, the EGPWS computer also does these auxiliary functions:

- Input signal processing (including filtering and signal monitoring)
- Alert output processing (including alert prioritization, voice message synthesis, audio output and display, and warning lamp drivers)
- Built-in test and monitoring, including cockpit-activated self-test
- Front panel maintenance test connector, test button, and headphone jack for system checkout and troubleshooting
- System status light-emitting diodes (LEDs) located on the front panel to indicate EXTERNAL FAULT, COMPUTER OK, and COMPUTER FAIL conditions
- Provisional cockpit and portable data loader interfaces for software uploading.

(3) The EGPWS computer provides basic ground proximity warning system (GPWS) alerting in six modes. Modes 1 through 5 are per the requirements of TSO-C92c, DO-161A, CAA Spec 14, and ICAO Annex 6. Mode 6 provides additional protection in the form of an optional alert for excessive bank angle.

(4) The basic ground proximity warning modes are tailored for an application by selection of various options which are program pin-selectable during installation of the EGPWS computer. An audio declutter feature, which activates the voice alert once, then not again unless the situation has degraded by 20 percent, is standard. This feature applies to modes 1, 3, 4, and 5. As an option, the audio declutter feature can be disabled (continuously repeating the audio message until the alerting situation is corrected) by program pin option.

B. Modes

(1) Mode 1 provides alerts when the aircraft has excessive descent rate close to the terrain. If the aircraft penetrates the “outer” alert boundary, the aural message SINKRATE is generated, and alert discretes are output by the computer for driving visual annunciators. If the aircraft penetrates the “inner” alert boundary, the aural message PULL UP is generated, and visual alert discretes are also output. The alert boundaries are defined in terms of aircraft vertical speed (barometric vertical speed supplemented by inertial vertical speed when available) and radio altitude.

(2) Mode 2 provides alerts when the aircraft is closing with the terrain at an excessive rate. It is not necessary for the aircraft to be descending in order to produce a Mode 2 alert; level flight or even a climb towards obstructing terrain can result in hazardous terrain closure rate. The terrain closure rate variable is computed within the EGPWS computer by combining radio altitude and vertical speed in a nonlinear complementary filter. Mode 2 has two submodes, referred to as Mode 2A and Mode 2B, the active submode being determined by aircraft configuration. Mode 2A is enabled when the conditions for enabling Mode 2B are not satisfied. If the aircraft penetrates the Mode 2A alerting envelope, the aural message TERRAIN TERRAIN is initially generated, and alert discretes are output for driving visual annunciators. If the aircraft continues to penetrate the envelope, then the aural message PULL UP is continuously repeated until the warning envelope is exited. At this point, an altitude gain function activates. The aural message reverts to TERRAIN TERRAIN, but is only given if the terrain clearance still continues to decrease. The visual alert remains on until either the aircraft has gained 300 feet of barometric altitude, 45 seconds has elapsed, or the altimeter loses track. At that point, all visual alerts stop. The upper boundary of the Mode 2A alert envelope varies as a function of aircraft speed. As airspeed increases from 220 knots to 310 knots, the boundary expands to provide increased alert times at higher airspeeds.

(3) Mode 3 provides alerts when the aircraft loses a significant amount of altitude immediately after takeoff, or during a missed approach. The altitude loss variable is based on the altitude above sea level (ASL) value at the beginning of the inadvertent descent. The amount of altitude loss permitted before an alert is given is a function of the height of the aircraft above the terrain. Mode 3 is enabled after takeoff or go-around when landing gear or flaps are not in landing configuration, and stays enabled until the EGPWS computer detects that the aircraft has gained sufficient altitude that it is no longer in the takeoff phase of flight. If the aircraft penetrates the Mode 3 boundary, the aural message DON'T SINK is generated, and alert discretes are provided for activation of visual annunciators. The visual annunciators remain active until a positive rate of climb is reestablished.

(4) Mode 4 provides alerts and warnings for insufficient terrain clearance with respect to phase of flight and speed. Mode 4 exists in three forms, 4A, 4B, and 4C. Mode 4A is active during cruise and approach with gear not in landing configuration. Mode 4B is also active in cruise and approach, but with gear in landing configuration. Mode 4C is active during the takeoff phase of flight with either gear or flaps not in landing configuration. The standard upper boundary for Mode 4A is at 500 feet radio altitude. If the aircraft penetrates this boundary with the gear still up, the voice message is TOO LOW GEAR. Above 190 knots, the upper boundary increases linearly with airspeed to a maximum of 1,000 ft radio altitude at 250 knots or more. Penetrating this boundary produces a TOO LOW TERRAIN message. When the landing gear is lowered, the upper boundary decreases to 245 ft. Penetration below 159 knots results in the TOO LOW GEAR message with gear up, or the TOO LOW FLAPS message with gear down and flaps not in landing configuration, while above 159 knots the message is TOO LOW TERRAIN. Mode 4C is based on a minimum terrain clearance, or floor, that increases with radio altitude during takeoff. A value equal to 75 percent of the current radio altitude is accumulated in a long-term filter. Any decrease of radio altitude below the filter value with gear or flaps up will result in the warning TOO LOW TERRAIN.

(5) Mode 5 provides two levels of alerting when the aircraft flightpath descends below the glideslope beam on front course ILS approaches. The first alert activation occurs whenever the aircraft is more than 1.3 dots below the beam. This is called a “soft” glideslope alert because the volume level of the GLIDESLOPE alert is approximately one half (-6 dB) that of the other alerts. A second alert boundary occurs below 300 ft radio altitude with greater than 2 dots deviation, and is called “loud” or “hard” glideslope alert because the volume level is increased to that of the other alerts. Other variations to the Mode 5 alert boundaries are:

- Envelope modulation
- Localizer intercept.

(6) Mode 6 provides alerts for excessive roll or bank angle. The “excessive bank angle” aural alerts are given twice and then suppressed unless the roll angle increases by an additional 20 percent.

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SECTION 2-8
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM

1. Overview

A. General

(1) The CAS 67A TCAS II supplies added protection against collisions with other aircraft by interrogating ATC transponders on aircraft in the vicinity and analyzing the replies. The potential collision threat level is determined and presented aurally/visually to the flightcrew.

(2) The TCAS system monitors airspace around its aircraft by interrogating an intruder aircraft's transponder. The TCAS processor computes the range, differential altitude, bearing, and closure rate of the intruder. It then compares this data to its own position and determines the potential for collision. Audio messages and visual displays of traffic advisories and collision resolution advisories are produced when required.

2. Component Location and Description

A. TCAS II Computer

(1) The TCAS II computer is located in the nose compartment of the aircraft. Figure 2-8-1 shows a graphical view of the TCAS II computer. Table 2-8-1 gives items and specifications particular to the TCAS II computer.

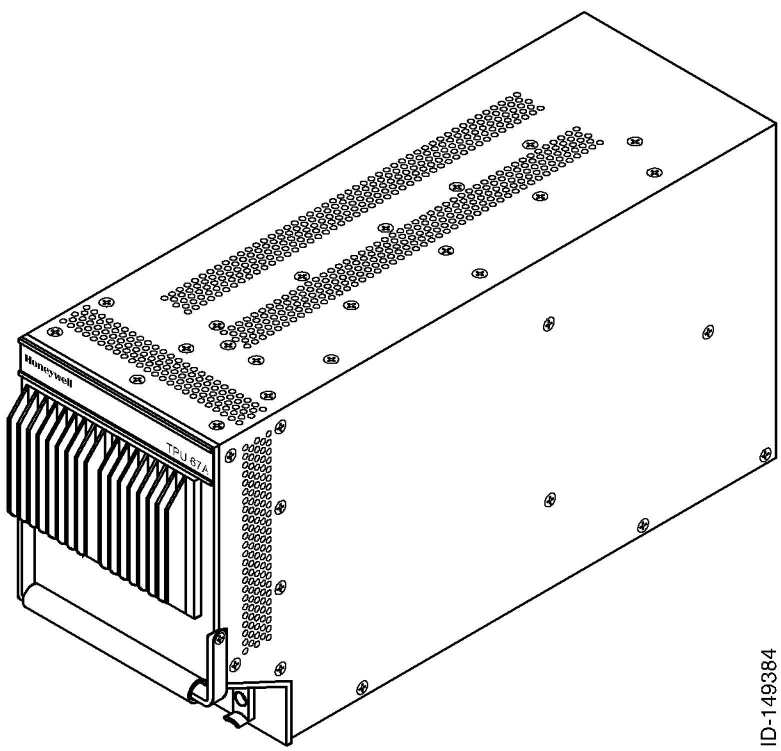

Figure 2-8-1. TCAS II Computer

Table 2-8-1. TCAS II Computer Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	7.7 in. (195.6 mm)
• Width	5.13 in. (130.3 mm)
• Length	14.95 in. (379.7 mm)
Weight (maximum)	17.2 lb (7.80 kg)
Power requirements	28 V dc, 77 W (maximum
User replaceable parts	None
Mating connectors	HPN 030-03157-0000, HPN 030-02707-0002
Mounting tray	HPN 047-09855-0004

B. TCAS Top and Bottom Antennas

(1) The TCAS top antenna is located on the top forward fuselage of the aircraft, and the TCAS bottom is located on the bottom forward fuselage. Figure 2-8-2 shows a graphical view of the TCAS antenna. Table 2-8-2 gives items and specifications particular to the TCAS antenna.

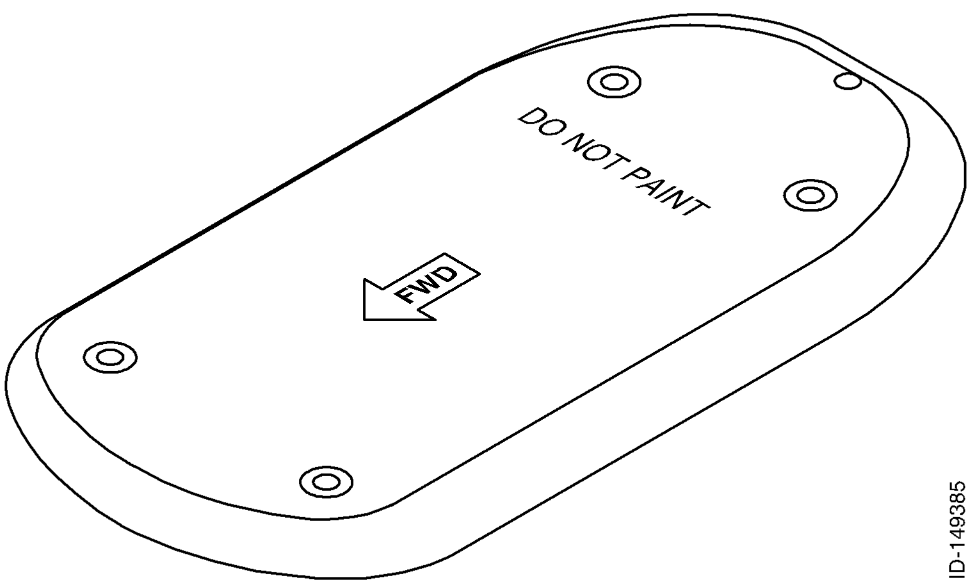

Figure 2-8-2. TCAS Antenna

Table 2-8-2. TCAS Antenna Leading Particulars

Item	Specification
Dimensions (maximum):	
• Height	1.36 in. (34.54 mm)
• Width	6.25 in. (158.75 mm)
• Length	11.00 in. (279.40 mm)
Weight (maximum)	1.82 lb (0.83 kg)

3. Operation

A. System Operation

(1) The basic TCAS II system performs traffic alert and collision avoidance functions to provide safe separation between own aircraft and other aircraft equipped with Mode S, ATCRBS Mode C, or ATCRBS Mode A/C transponders. TCAS II operation can be separated into functions that are described in the paragraphs that follow.

(a) Surveillance Function

1 The surveillance function detects the presence of Mode S or ATCRBS Mode A/C transponder equipped aircraft that are within TCAS surveillance limits. It compares raw replies with existing track files in order to update current track information or to create new track files.

(b) Tracking Function

1 The tracking function maintains tracking information files on Mode S, ATCRBS Mode C, and ATCRBS Mode A/C transponder-equipped intruder aircraft. The tracking information includes range, relative bearing (if valid information is received from a directional antenna), and relative altitude (if the target aircraft is reporting altitude). When that information is available, the TCAS II computes relative position, closing range, and altitude change rate.

(c) Collision Avoidance Computation and Resolution Advisory Display Function

1 If a resolution advisory threat aircraft is present, the TCAS determines the appropriate vertical maneuvering for own aircraft that will attain or maintain safe miss distance between own aircraft and intruder aircraft while creating the least deviation from own aircraft's vertical rate. It communicates advised maneuver to the pilot by means of a resolution advisory display on the traffic advisory/resolution advisory/vertical speed indicator units or resolution advisory/vertical speed indicator units.

(d) Threat Potential Evaluation Function

1 The threat potential evaluation function determines threat potential of intruder aircraft based on computations using tracking data. It categorizes intruders as resolution advisories, traffic advisories, proximity advisories, or nonthreats (other traffic).

(e) Traffic Advisory Display Function

1 The traffic advisory display function provides a display of traffic advisory, proximity, or nonthreat category traffic that are present in the surrounding airspace. The traffic display depicts the position and threat potential of intruder aircraft, which alerts the flightcrew to potentially dangerous situations. Depending on the aircraft equipment, the traffic display may appear on a traffic advisory/resolution advisory/vertical speed indicator unit, or an optional radar indicator, or dedicated TCAS display unit, or EFIS MFD display.

(f) Aural Alert Function

1 The aural alert function provides voice message advisory alerts on the cockpit audio system.

(g) Air-to-Air Coordination Function

1 If intruder aircraft is TCAS II equipped and becomes a threat, a maneuvering coordination data link is established with the intruder. This data link ensures that the resolution advisories in both TCAS II equipped aircraft are coordinated and compatible. The coordination links are established between the two TCAS II systems via the Mode S transponders.

SECTION 2-9
AA-300 RADIO ALTIMETER SYSTEM

1. Overview

A. General

(1) The radio altimeter system consists of the following:

- One RT-300 radio altimeter receiver transmitter
- Two AT-300 radio altimeter antennas.

(2) The RT-300 radio altimeter receiver transmitter is a remote-mounted unit, and the two AT-300 radio altimeter antennas are mounted through the skin on the underside of the aircraft. One antenna is for transmit, and one is for receive.

(3) The system generates a DC output voltage that is proportional to the aircraft absolute altitude, and an indicator warning flag output. These outputs are sent to both IACs where they are converted to avionics standard communication bus (ASCB) data for use by the EDS and other subsystems.

2. Component Description and Location

A. RT-300 Radio Altimeter Receiver Transmitter

(1) The receiver transmitters are located in the rear avionics rack of the aircraft. Figure 2-9-1 shows a graphical view of the receiver transmitter. Table 2-9-1 gives the specifications.

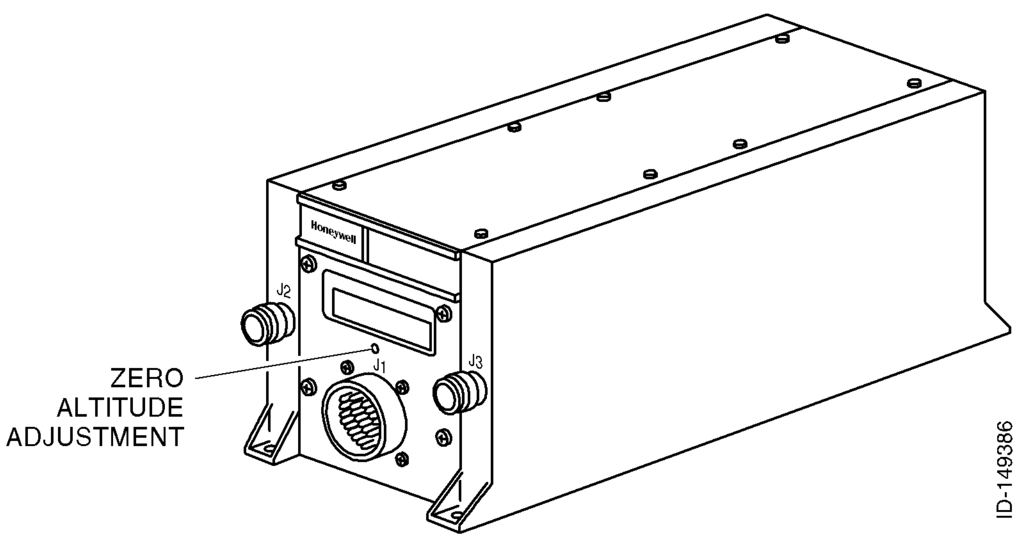

Figure 2-9-1. RT-300 Radio Altimeter Receiver Transmitter

(2) The receiver transmitter contains the necessary power supplies, radio frequency transmitting and receiving circuitry, and timing circuits with which to determine the aircraft absolute altitude. The system transmits radio frequency pulses, measures the time until the reflection is received, and hence determines the aircraft absolute altitude above terrain.

(3) It generates a DC output voltage that is proportional to the absolute altitude. It can also generate preset altitude trip outputs for other aircraft systems. These outputs supply a ground potential at or below the preset altitudes of 50, 250, 500, and 1,200 ft.

Table 2-9-1. RT-300 Radio Altimeter Receiver Transmitter Leading Particulars

Item	Specification
Dimensions (maximum):	
• Length	11.07 in. (281.2 mm)
• Width	4.56 in. (115.8 mm)
• Height	4.09 in. (104.0 mm)
Weight (maximum)	4.6 lb (2.09 kg)
Power requirements	28 V dc, 17 watts
Transmitter characteristics (nominal):	
• Type	Short pulse modulation
• Pulse width	100 nanoseconds
• PRF	Jittered between 12.5 and 50 kHz
• RF frequency	4.3 GHz
• Peak power	5 watts
Receiver characteristics (nominal):	
• Type	Superheterodyne
• IF frequency	60 MHz
Operational altitude	0-2,500 ft
Data outputs/accuracy:	
• Precision output Gradient:	DC analog voltage (0 - 2500 ft) -4.0 mV dc/ft 0 alt = 0 volt
Accuracy:	0 - 100 ft, ±3 ft 100 - 500 ft, ±3% 500 - 2,500 ft, ±4%

Table 2-9-1. RT-300 Radio Altimeter Receiver Transmitter Leading Particulars (cont)

Item	Specification
• Auxiliary output Gradient:	DC analog voltage (0 - 2,500 ft) Per ARINC 552, Alt = 0.02h + 0.4 V dc below 480 ft and $10 + 10 \ln \frac{h + 20}{500}$ V dc above 480 ft
Accuracy:	0 - 100 ft, ±4 ft 100 - 500 ft, ±4% 500 - 2,500 ft, ±5%
User replaceable parts	None
Mating connectors:	
• J1	MS3116F16-26S
• J2 - TRANSMIT	TNC - male (Straight) GRFF 4007-0002
• J3 - RECEIVE	TNC - male (Straight) GRFF 4007-0002 (GRFF connectors, GRFF Division, Solitron Devices, Inc)
Mounting	Hard mount

B. AT-300 Radio Altimeter Antenna

(1) Figure 2-9-2 shows a graphical view of the AT-300 radio altimeter antenna. The antennas are located on the bottom and rear of the aircraft. Table 2-9-2 lists items and specifications that are particular to the antenna.

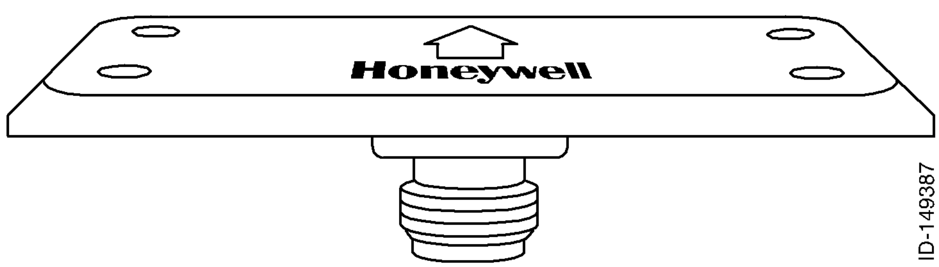

Figure 2-9-2. AT-300 Radio Altimeter Antenna

Table 2-9-2. AT-300 Radio Altimeter Antenna Leading Particulars

Item	Specification
Dimensions (maximum):	
• Length	3.65 in. (92.7 mm)
• Width	3.50 in. (88.9 mm)
• Height (including connector)	0.93 in. (23.6 mm)
Weight (maximum)	3.5 oz (99.22 g)
User replaceable parts	None
Mating connectors:	
• J1	TNC - male (Straight) GRFF 4007-0002 (Right angle) GRFF 4100-0001
Mounting	Flush mounted to aircraft skin, using No. 10 panhead screws and gasket, HPN 4010193-6

(2) One antenna radiates the transmitted signal, and the other antenna converts the received radio frequency energy to radio frequency voltage for the receiver transmitter receiver circuitry.

3. Operation

A. Introduction

(1) The AA-300 series radio altimeter is a dual antenna, short pulse system designed to supply the flightcrew with absolute altitude above the terrain information, from zero to 2500 ft. The system is designed for automatic continuous operation over wide variations of terrain, weather, target reflectivity, and aircraft attitude.

(2) Radio altitude information is displayed on the pilot's and copilot's PFDs. If a failure occurs, an annunciation appears on the PFDs to alert the pilots.

(3) In a dual radio altimeter installation, there is automatic reversion to the cross-side radio altimeter until a data acquisition unit (DAU) reversion is accomplished, then back to channel B of the DAU if valid.

(4) The AA-300 system also has the ability to supply preset altitude trip outputs to other aircraft systems. See Figure 2-9-3 for AA-300 radio altimeter system interface information. Refer to Table 2-9-3 for performance accuracy information.

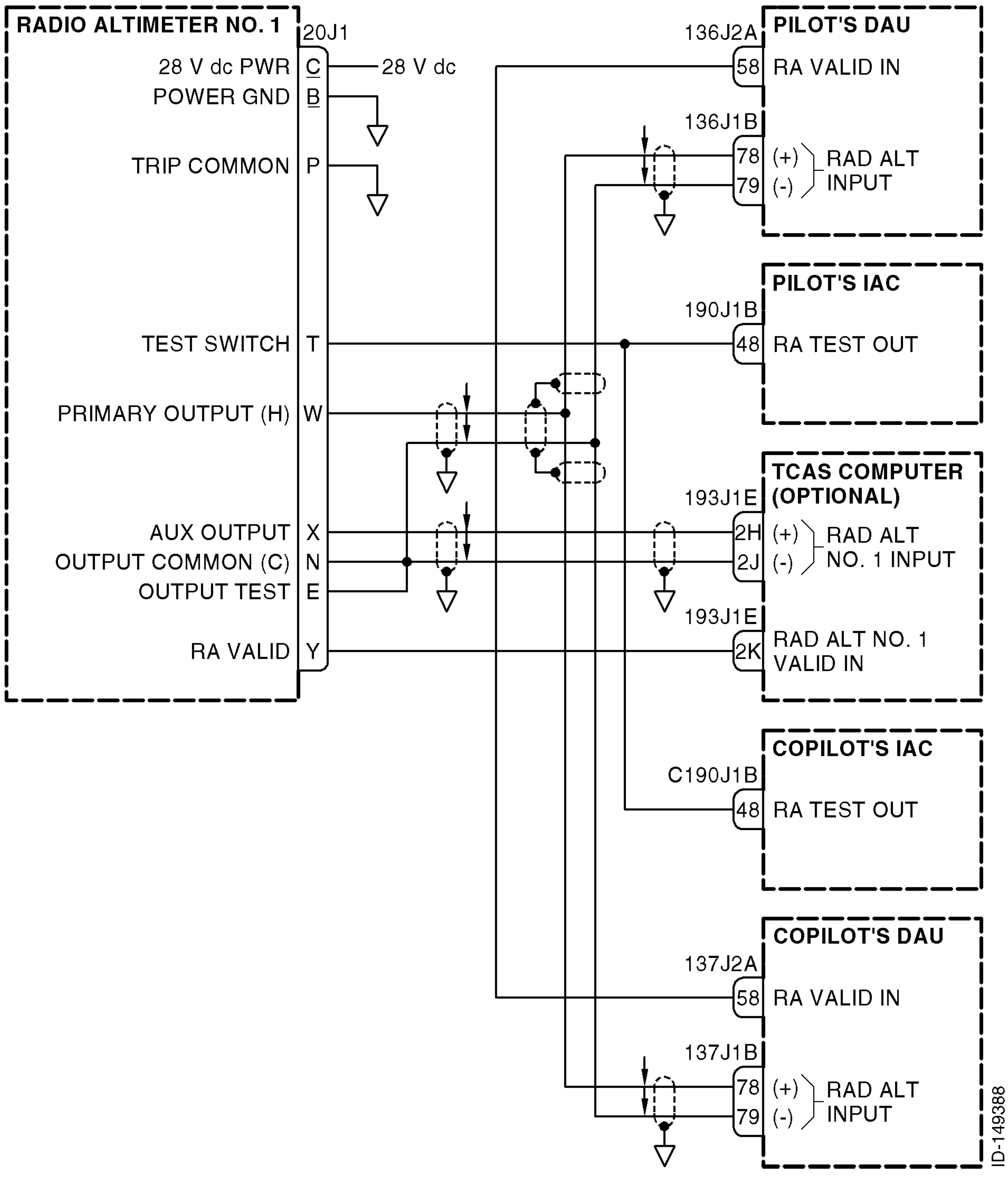

Figure 2-9-3. Radio Altimeter System Interface

Table 2-9-3. Radio Altimeter System Performance Accuracy

	Gradient	Accuracy
Precision output	-4.0 mV dc/ft 0 ALT = 0 volts	0 - 100 ft, ±3 ft 100 - 500 ft, ±3% 500 - 2,500 ft, ±4%
Auxiliary output	Per ARINC Spec 552 0 ALT = +400 mV	0 - 100 ft, ±4 ft 100 - 500 ft, ±4% 500 - 2,500 ft, ±5%

B. Modes of Operation

(1) Normal Operation

(a) The AA-300 system is normally on and operating prior to takeoff. At altitudes within the useable range, proper system operation is indicated by the absolute altitude (radio altimeter) being displayed on the PFDs. As the aircraft leaves the useable range environment, the radio altimeter display is automatically removed from the PFDs.

(2) Decision Height (DH) Set

(a) The height reference selection knob is a three-way control that allows the selection of either a DH or a minimum descent altitude (MDA) reference. Refer to Table 2-9-4 for decision height set.

Table 2-9-4. Decision Height Set

Decision Height	Height
Power-up default (DH/MDA per switch selection	On ground = invalid (amber dashes) In air = previous value
Range	0 to 2,500 ft

(b) The outermost ring of the knob is a two-position switch that selects the type of reference to be set and displayed, DH or MDA. Selecting between the two types enables the display of the last reference set of that type. DH is a setting that uses a radio altitude reference, while the MDA setting is using a barometric altitude reference.

(c) The inner ring is the reference set selection knob. Turning this knob changes the currently displayed value in 10-ft increments. The range of the control knob is limited to the range stated above. Continued rotation of the knob while at the limit results in the value remaining at the limit. Following power-up, the first click of the knob resets the height readout to 20.

(d) The inner pushbutton activates a preset reference value of 200 ft for DH or 1,500 ft for MDA. The button can be used following power-up to select the preset value.

(e) The in-air power-up default is set to the value selected prior to power-down. The value is set to invalid if the previous value was invalid. Under this condition, it is possible to use the preset value or to use the knob for height selection. The first click of the knob sets the reference to zero.

(3) AA-300 Test Function

CAUTION: DO NOT APPLY POWER TO THE RADIO ALTIMETER SYSTEM UNLESS THE TRANSMIT ANTENNA IS PROPERLY CONNECTED TO THE RECEIVER TRANSMITTER. IF THE TRANSMIT ANTENNA IS NOT CONNECTED, THE UNIT WILL BE DAMAGED.

(a) The test function for the radio altimeter is initiated through the use of the bezel buttons located on the MFD.

(b) Initiating the test function causes the radio altimeter displays on the PFDs to read 100 ft. The test function is inhibited when the flight guidance system is in the glideslope/glidepath capture or track mode of operation.

4. Fault Monitoring

A. PFD Fault Indications

(1) Fault indications are presented on the PFD. Loss of valid radio altitude information causes the following to happen:

- In a dual radio system where both systems fail, or a single system fails, the radio altitude digital readout is replaced with a boxed red RA shown in the attitude sphere.
- In a dual radio system and one system fails, RA 1 - 2 is shown in amber, under the attitude digital readout, showing which RA is working.
- Removal of the radio altitude brown scale.

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SECTION 3
SYSTEM INTERCONNECT

1. Overview

A. General

(1) The interconnect information is based on Honeywell Engineering Bulletin EB7032923. For specific system interconnect avionics wiring information, refer to the wiring diagrams in the Cessna Citation XLS AMM.

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SECTION 4
MAINTENANCE PRACTICES

1. Overview

A. General

CAUTION: IF INSTALLATION CRITICAL CONDITIONS OCCUR WHEN YOU INSTALL A UNIT, YOU MUST OBEY ALL OF THE INSTRUCTIONS.

CAUTION: BEFORE YOU REMOVE OR INSTALL A UNIT, DE-ENERGIZE THE AIRCRAFT POWER. THIS WILL HELP PREVENT DAMAGE TO THE EQUIPMENT.

(1) This section provides instructions for removing, installing, and adjusting each LRU of the PRIMUS 1000 Integrated Avionics System that has been previously installed by the aircraft manufacturer or completion center. Where applicable, instructions for replacing lamps, knobs, and setscrews are included. Adjustment information is called out as required.

B. Antenna Information

(1) The paragraphs that follow give general information for the removal and installation of antennas.

NOTE: For all antennas not supplied by Honeywell, removal and installation should be in accordance with the manufacturer's installation instructions.

(2) Antenna Weather Protection

(a) Some antennas require gaskets, and others have O-rings. When installing antennas, new gaskets or O-rings should be used.

(b) A weather sealant should be applied around the periphery of the antenna base to prevent seepage of water and condensation and to preclude corrosion. If a sealant or aerodynamic smoother is used around the periphery of the antenna base, it should be applied after the antenna has been bolted down. The sealant used should be nonadhering to allow the antenna to be removed at a later time if necessary. Chromatic tape is recommended.

(c) When mounting antennas on a pressurized fuselage, a leveling and sealing compound such as Pro-Seal 870B-1/2 should be used between the entire mounting surface of the antenna and the fuselage. Use of this compound, in addition to the installation gasket, compensates for surface irregularities and voids between the antenna and the fuselage. A mold releasing agent can be used on the fuselage prior to installation to prevent the leveling compound from adhering to the fuselage.

(d) To prevent water seepage on top-mounted antennas, it may be necessary to apply Silastic sealant (RTV-3145 or equivalent) to the mounting screw heads.

(3) Antenna Hardware

(a) Clean the airframe at the antenna mounting area to remove any foreign material.

(b) Because of the insulation qualities of gaskets and leveling compounds, the mounting screws are required to provide the electrical bonding between the antennas and the aircraft (typically 15 milliohms or less is required). Therefore, the technician doing the reinstallation must be sure that any hardware being reused is clean and free of corrosion. If in doubt, use new hardware.

(c) Gaskets and O-rings deform during initial installation. While it is possible to reuse gaskets and O-rings, it is highly recommended that new gaskets or O-rings be used.

(4) General Antenna Removal Instructions

(a) To prevent damage to the antennas, do not apply pressure to or pry on plastic housings.

(b) Pull the applicable circuit breakers.

(c) After you remove and save the hardware, cut the bond line of any installer-applied sealant between the antenna and the aircraft skin.

(d) Pull the antenna away from the aircraft skin far enough to disconnect the cable connector(s).

2. Equipment and Materials

A. General

(1) Equivalent alternatives are permitted for materials in this list. It is the responsibility of the user to determine equivalent alternatives.

(2) Refer to the applicable leading particulars table in Section 2, System Description, for replacement gaskets, lamps, knobs, and setscrew part numbers.

(3) No additional special equipment or materials, other than those commonly used in the shop, are required to install the units in existing trays and clamps and to adjust the system. Do not overtighten the mounting screws. Where torque values are not given, it is acceptable to finger-tighten the mounting screws.

B. Equipment

(1) Augat, Part No. T-114-1, IC puller is used as a button puller when replacing lamps on the MS-560 mode selector or PC-400 autopilot controller.

(2) Uploading/downloading of the checklist files requires the equipment that follows:

- IBM compatible laptop personal computer (PC)
- ECP-800 programmable checklist, Part No. 7021060-901 (includes 9-pin RS-232 cable).

C. Materials

WARNING: BEFORE YOU USE A MATERIAL, REFER TO THE MANUFACTURERS' MATERIAL SAFETY DATA SHEETS FOR SAFETY INFORMATION. SOME MATERIALS CAN BE DANGEROUS.

CAUTION: DO NOT USE MATERIALS THAT ARE NOT EQUIVALENT TO MATERIALS SPECIFIED BY HONEYWELL. MATERIALS THAT ARE NOT EQUIVALENT CAN CAUSE DAMAGE TO THE EQUIPMENT AND CAN VOID THE WARRANTY.

(1) Maintenance materials that are identified with a Honeywell material number (HMN) are given in Table 4-1.

Table 4-1. HMN Materials

Item	Description	Source
HMN 97D0878	Retaining compound - Loctite Assure No.425 surface curing threadlocker	Loctite Corp, Newington, CT
HMN 97P5778	Adhesive-sealant, high strength, noncorrosive, RTV, silicone (MIL-A-46146, Type III) - No. DC-3145 (translucent) RTV	Dow Corning Corp, Midland, MI
HMN 98C0978	Sealant, corrosion inhibitive (MIL-S-81733, Type II-1/2 - for extrusion application in the time of 1/2 hour) — Pro-Seal 870B-1/2	Courtaulds Aerospace formerly Products Research and Chemical Corp, Coating and Sealants Div, Glendale, CA

3. Procedure for the AZ-950 MADC

A. Removal and Installation Procedures

(1) Remove the MADC as follows:

(a) Disconnect the pitot and static lines. Cap or cover the hose end connectors to keep debris out of the system.

(b) Disconnect the cable connector.

(c) Use a 3/16-in. Allen wrench to loosen the jackscrew until the hold-down hook releases the MADC.

(d) Slide the MADC out of the tray.

(2) Install the MADC as follows:

(a) Slide the MADC into the mounting tray.

(b) Make sure that the rear boss engages the mounting tray slot.

(c) Make sure that the hold-down hook engages the boss on the MADC. Use a 3/16-in. Allen wrench to tighten the jackscrew.

(d) Mate the cable connector and the unit connector.

(e) Connect the pitot and static lines and perform the appropriate pitot/static leak check as instructed in the aircraft maintenance manual.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Not applicable.

4. Procedure for the RM-855 RMU

A. Removal and Installation Procedures

(1) Remove the RMU as follows:

(a) Loosen the clamp screws on the panel at each top corner of the unit.

(b) Without turning the screws, push them straight into the panel. This releases the clamp.

(c) Slide the RMU out of the panel and disconnect the cable connector.

(2) Install the RMU as follows:

(a) Mate the cable connector with the RMU connector.

(b) Slide the RMU into the panel.

(c) Tighten the clamp screws at each top corner of the unit.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the tuning knobs as follows:

(a) Use a 0.060-in. outside diameter, six flute Bristol wrench to loosen the setscrews.

(b) Remove the defective knob.

(c) On new knobs, make sure that the setscrews are out far enough to allow the knob to slide onto the shaft. Apply retaining compound to the setscrews.

(d) Slide the large tuning knob onto the shaft.

(e) Make sure that the space between the knob and the bezel is approximately 0.025 in. (0.6 mm).

(f) Tighten both setscrews with the Bristol wrench.

(g) Recheck the spacing between the knob and the bezel to make sure that the knob has not slipped during installation.

(h) Slide the small tuning knob onto the shaft. Make sure that the small tuning knob does not rub against the large tuning knob.

(i) Align the access holes in the large tuning knob with the setscrews in the small tuning knob.

(j) Tighten both setscrews with the Bristol wrench.

(k) Do another check to make sure that the small tuning knob has not slipped during installation and that it is not rubbing against the large tuning knob.

5. Procedure for the RNZ-850/850B Integrated NAV Unit

A. Removal and Installation Procedures

(1) Remove the integrated NAV unit as follows:

(a) Cut the safety wire and loosen the thumbnuts.

(b) Slowly pull forward on the unit handle to separate the unit and tray connectors and slide the unit out of the tray.

(2) Install the integrated NAV unit as follows:

(a) Examine the connector pins to make sure that the pins are not bent or damaged.

CAUTION: DO NOT USE TOO MUCH FORCE WHEN YOU INSTALL THE UNIT ON THE MOUNTING TRAY. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE CONNECTOR PINS.

(b) Put the unit on the mounting tray. Carefully slide the unit backward until its connectors are fully engaged with the mating connectors of the mounting tray.

(c) Tighten the thumbnuts and attach the safety wire.

NOTE: Instructions for the removal and installation of a navigation module are included with the replacement module.

B. Adjustment Procedures

(1) All adjustments on the NAV unit are set at the factory for typical operating conditions. Most NAV unit installations should not require any adjustments. If an adjustment is necessary, perform the adjustment in accordance with the procedures that follow. NAV units have holes in the top cover, and the holes are labeled. See Figure 4-1 for NAV unit adjustment locations.

(2) Some of the procedures that follow refer to digital and analog audio signals. The digital audio is the normal audio from the AV-850A audio panel. The analog audio signals are the traditional audio signals used in aircraft. The VOR/LOC analog audio is used for the emergency backup audio system.

(3) LOC Audio Level Adjustment

(a) The LOC audio adjustment controls the VOR/LOC receiver emergency audio level out of the AV-850A audio panel. This adjustment does not affect the digital audio level from the AV-850A audio panel. Emergency audio for the VOR/LOC is a backup system for the digital audio and is connected on the side of the aircraft that has the CD-850 CDH installed.

(b) Before making any adjustments of the LOC audio level, do the procedure that follows to determine if adjustment is needed.

1 Set the HEADPHONE volume control on the AV-850A audio panel to its typical operating position. Push in the EMER button on the audio panel.

2 Push the NAV AUDIO button on the CD-850 CDH and verify that NAV AUDIO shows on the CDH display.

3 Tune the CDH to a VOR station (either in flight or on the ground) and verify a flag-out-of-view condition on an indicator.

4 Listen to the VOR emergency audio with a set of headphones.

5 Adjust the audio level as follows:

- Find the LOC AUDIO adjustment on top of the NAV unit and increase or decrease audio level as desired.
- For an increase of audio level, turn the adjustment clockwise.
- For a decrease of audio level, turn the adjustment counterclockwise.

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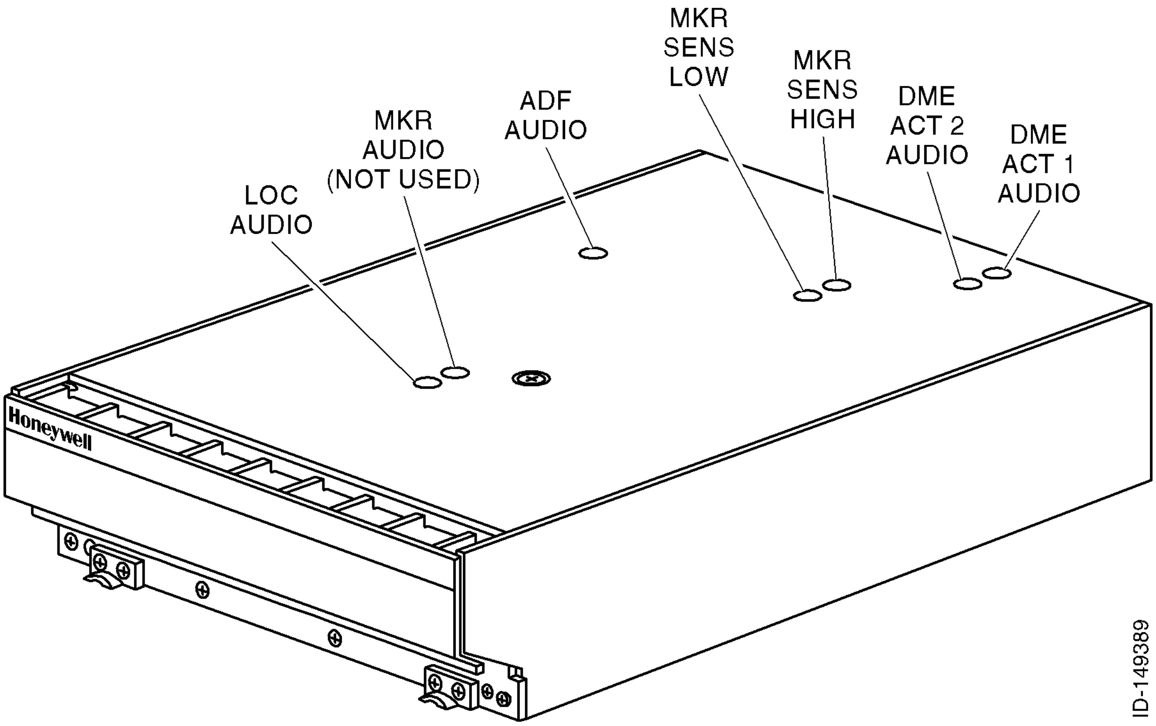

Figure 4-1. NAV Unit Adjustment Locations

(4) MKR High and Low Sensitivity Threshold Adjustments

(a) The MKR high and low sensitivity adjustments control how long the marker lamps are ON and how long the marker audio is heard when crossing a marker ground station. These adjustments do not affect the marker digital or analog audio output levels, only the duration of the marker audio and display.

(b) The high sensitivity mode is typically used for enroute flying. The high altitudes and low sensitivity modes are typically used during approach, and the low altitudes typically when flying an ILS.

(c) To determine if either high or low sensitivity needs adjustment, do the following flight-test procedure:

(d) Electromagnetic Compatibility

1 With all aircraft avionics systems operating in flight, verify by observation that no adverse effects are present.

(e) Marker Beacon Performance Checks

1 In low sensitivity mode, the marker beacon annunciator light should be illuminated for a distance of 2,000 to 3,000 ft when flying at an altitude of 1,000 ft AGL on the localizer centerline in all flap and gear configurations.

2 To determine distances of 2,000 to 3,000 ft, time the marker beacon light duration, determine groundspeed, and then use the formulas shown below:

$$\text{Upper limit} = \frac{1{,}775 \text{ seconds}}{\text{groundspeed in knots}}$$

$$\text{Lower limit} = \frac{1{,}183 \text{ seconds}}{\text{groundspeed in knots}}$$

3 In high sensitivity mode, the marker beacon annunciator light and audio remain on longer than when in low sensitivity.

4 The audio signal should be of adequate strength and sufficiently free from interference to provide positive identification.

5 As an alternate procedure, cross the outer marker at normal ILS approach altitudes and determine adequate marker aural and visual indication. When adjusting marker high and low sensitivity thresholds, the high sensitivity adjustment must always be set to the desired threshold before low sensitivity adjustment is performed.

6 Find the adjustments on top of the NAV unit. To cause the marker lamps and audio to stay ON for a shorter length of time, turn the MKR SENS HIGH or MKR SENS LOW adjustment clockwise.

(5) ADF Audio Level Adjustment

(a) The ADF AUDIO adjustment controls the ADF receiver analog audio level. This adjustment does not affect the digital audio output level from the AV-850A audio panel.

(b) For an increase of audio level, turn the adjustment clockwise.

(c) For a decrease of audio level, turn the adjustment counterclockwise.

(6) DME Audio Level Adjustment

(a) The DME audio adjustments control the DME analog audio levels. These adjustments do not affect the digital output level from the AV-850A audio panel.

(b) For an increase of audio level, turn the adjustment clockwise.

(c) For a decrease of audio level, turn the adjustment counterclockwise.

C. Repair Procedures

(1) Not applicable.

6. Procedure for the RNZ-850/RCZ-851E Strap Board Assembly

CAUTION: THE UNIT CONTAINS ITEMS THAT ARE ELECTROSTATIC DISCHARGE SENSITIVE. OBEY APPROVED INDUSTRY PRECAUTIONS WHEN YOU TOUCH, REMOVE, OR INSTALL PARTS OR UNITS. DAMAGE CAN OCCUR FROM ELECTROSTATIC DISCHARGE.

A. Removal and Installation Procedures

(1) Remove the strap board assembly as follows:

NOTE: The integrated radio system contains a total of four strap board assemblies. One COM and one NAV assembly is contained in each remotely mounted strapping assembly.

(a) Remove the two screws and cover from the strapping assembly.

(b) Remove and set aside the three roundhead screws and lockwashers that attach the COM or NAV strap board assembly.

(c) Hold the strap board assembly by its edges and gently pull out on the assembly. Disconnect the flat connector from the assembly.

(2) Install the strap board assembly as follows:

CAUTION: BE VERY CAREFUL WHEN YOU CUT THE CONFIGURATION STRAPS TO PREVENT DAMAGE TO THE STRAP BOARD ASSEMBLY.

(a) If the strap board assembly is removed from the aircraft and replaced with an assembly from customer-owned shelf stock or was obtained from Honeywell, the configuration straps have to be cut in accordance with the AMM for the Cessna Citation XLS.

(b) Hold the strap board assembly by its edges and attach the flat connector to the assembly.

(c) Secure the assembly using the three roundhead screws and lockwashers that were removed and previously set aside.

(d) Make sure that the harness grommet is positioned at the bottom of the slot in the chassis.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Not applicable.

7. Procedure for the DC-550 Display Controller

A. Removal and Installation Procedures

(1) Remove the display controller as follows:

(a) Disengage the Dzus fasteners on the unit.

(b) Slide the unit out of the aircraft mounting location and disconnect the cable connector.

(2) Install the display controller as follows:

(a) Mate the cable connector with the unit connector and slide the unit into the aircraft mounting location.

(b) Engage the Dzus fasteners on the unit.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the bearing control knobs as follows:

(a) Use a 1/32-in. Allen wrench to loosen both setscrews in the knob.

(b) Slide the knob off the shaft.

(c) Examine the new knob and make sure that the setscrews are out far enough to allow the knob to slide onto the shaft. Apply retaining compound to the setscrews.

(d) Slide the knob onto the shaft. Do not tighten the setscrews.

(e) Make sure that the space between the knob and the bezel is approximately 0.030-in. (0.8 mm).

(f) Use a 1/32-in. Allen wrench to tighten the setscrews in the knob.

(g) Visually check the spacing between the knob and the bezel to make sure that the knob has not slipped during installation.

(2) Replace the DH/TEST and PFD DIM knobs as follows:

(a) Use a 1/32-in. Allen wrench to loosen both setscrews in the DH/TEST knob.

(b) Slide the knob off the shaft.

(c) Use a 0.048-in. Bristol wrench to loosen both setscrews in the test switch hub.

(d) Slide the test switch hub off the shaft.

(e) Use a 1/32-in. Allen wrench to loosen both setscrews in the PFD DIM knob.

(f) Slide the knob off the shaft.

(g) Examine the new knob and make sure that the setscrews are out far enough to allow the knob to slide onto the shaft. Apply retaining compound to the setscrews.

(h) Slide the PFD DIM knob onto the shaft. Do not tighten the setscrews.

(i) Make sure that the space between the PFD DIM knob and the bezel is approximately 0.030 in. (0.8 mm).

(j) Use a 1/32-in. Allen wrench to tighten the setscrews in the PFD DIM knob.

(k) Visually check the spacing between the knob and the bezel to make sure that the knob has not slipped during installation.

(l) Slide the test switch hub onto the shaft.

(m) Use a 0.048-in. Bristol wrench to tighten the setscrews in the test switch hub.

(n) Slide the DH/TEST knob onto the shaft.

(o) Use a 1/32-in. Allen wrench to tighten the setscrews.

(p) Make sure that the DH/TEST knob has not slipped during installation, and that it is not rubbing against the inside of the PFD DIM knob.

8. Procedure for the IC-615 IAC

A. Removal and Installation Procedures

(1) Remove the IAC as follows:

(a) Loosen the mounting tray hold-down knob.

(b) Slowly pull forward on the unit handle to separate the unit and tray connectors and slide the unit out of the tray.

(2) Install the IAC as follows:

NOTE: Make sure that the correct part number IAC is installed.

(a) Examine the connector pins to make sure that the pins are not bent or damaged.

CAUTION: DO NOT USE TOO MUCH FORCE WHEN YOU INSTALL THE UNIT ON THE MOUNTING TRAY. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE CONNECTOR PINS.

(b) Put the unit on the mounting tray. Carefully slide the unit backward until its connectors are fully engaged with the mating connectors of the mounting tray.

(c) If necessary, gently lift the front of the unit to make sure that the hold-down assembly mates properly with the tray hold-down hooks.

(d) Tighten the hold-down knob.

B. Checklist Loading Procedures

(1) The MFD checklist is stored in each IC-615 IAC.

(2) The aircraft must be on the ground (WOW) and powered up in standby.

(3) Connect a PC to the applicable 9-pin aircraft connector using a RS-232 interconnect cable supplied with the ECP-800 programmable checklist. There are two aircraft connectors: one connected to the pilot's IC-615 and one connected to the copilot's IC-615.

(a) The PC must have the ECP-800 programmable checklist software, Honeywell Part No. 7021060-901, and the desired checklist available for use. Refer to the ECP-800 programmable checklist manual for details.

(b) If the PC has Windows 3.1 or 95, do not access the ECP-800 software from the Windows prompt. Instead, use the DOS prompt to start the checklist software.

(4) Apply power to the avionics. Observe that the RA SET area on the PFD is valid.

(5) On the onside DC-550 display controller, use the RA knob to set 890 RA on the PFD.

(6) Push and hold the display controller TEST button for a minimum of 10 seconds, and while holding the TEST button, momentarily push the display controller ET button. See Figure 4-2 for the display that appears on the onside PFD.

```
CHECKLIST LOADING

PROGRAMMABLE CHECKLIST
EQUIPMENT IS REQUIRED

SCREEN WILL BLANK

CYCLE IC-615 CIRCUIT
BREAKER TO RECOVER

DC550 PUSHBUTTONS                890 RA
NAV    ENTER CKLST
```

ID-149390

Figure 4-2. Checklist Loading Page

(7) Momentarily push the NAV button on the onside DC-550 display controller. The PFD momentarily blanks and a large red **X** is displayed. The red **X** remains until the IAC is powered down.

(8) Use the electronic programmable checklist software on the PC to output the checklist and upload it to the onside IAC. If a checklist is already in the IAC, error code 5100 is displayed on the PC. Follow the instructions on the PC.

(9) When the upload is complete, follow the instructions on the PC to finish.

(10) Pull the appropriate IAC circuit breaker to power down the IAC.

(11) Remove the RS-232 cable from the aircraft connector.

(12) Push in the appropriate IAC circuit breaker to power up the IAC.

(13) When the IAC is powered up, verify that the checklist can be selected by pushing either the NORM or EMER buttons, which are selectable on the onside MFD bezel menu.

(14) Review the checklist for accuracy.

(15) The procedure is complete. If applicable, perform this procedure to load the checklist in the other IAC.

C. Repair Procedures

(1) Replace the IC-615 battery as follows:

(a) Remove the IC-615 LRU from the aircraft.

(b) Find the battery cover below the two cooling fans in the rear of the IC-615 case. See Figure 4-3 for the battery cover location.

(c) Loosen each of the four Phillips-head screws from the corners of the battery cover until the battery cover becomes free.

(d) Remove the battery cover from the IC-615 case to get access to the battery connector.

(e) Pull the battery connector plug apart to disconnect the cover and battery from the IC-615 case.

NOTE: The battery connector is a two-piece plug that easily pulls apart.

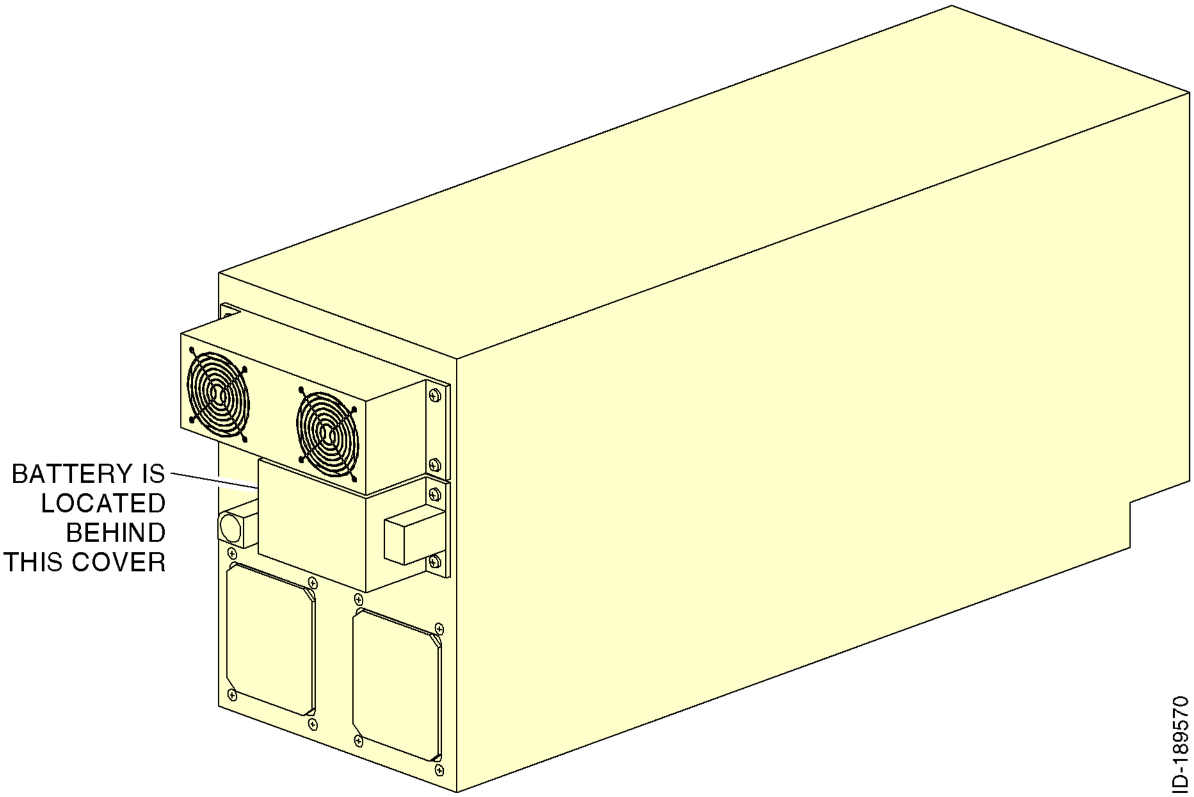

Figure 4-3. IC-615 Battery Cover Location

(f) To remove the battery from the battery cover, loosen the Phillips-head screw on the secure bar and remove the secure bar.

(g) Remove the expired battery and put the replacement battery into the battery cover.

(h) Replace the secure bar and tighten the Phillips-head screw on the secure bar.

(i) Connect the battery connector plug.

(j) Install the battery cover onto the back of the IC-615 case.

(k) Attach the battery cover to the IC-615 case with the previously saved four Phillips-head screws.

(l) Install the IC-615 LRU in the aircraft.

9. Procedure for the MC-800 MFD Controller

A. Removal and Installation Procedures

(1) Remove the MFD controller as follows:

(a) Disengage the Dzus fasteners on the unit.

(b) Slide the unit out of the aircraft mounting location and disconnect the cable connector.

(2) Install the MFD controller as follows:

(a) Mate the cable connector with the unit connector and slide the unit into the aircraft mounting location.

(b) Engage the Dzus fasteners on the unit.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the control knobs as follows:

(a) Use a 0.048-in. Bristol wrench to loosen both setscrews on the DIM knob.

(b) Slide the knob off the shaft.

(c) Use a 0.048-in. Bristol wrench to loosen both setscrews on the MODE knob.

(d) Slide the knob off the shaft.

(e) Examine the new knobs to make sure that the setscrews are out far enough to allow the knob(s) to slide onto the shaft(s). Apply retaining compound to the setscrews.

(f) Slide the MODE knob onto the shaft.

(g) Make sure that the space between the MODE knob and the bezel is approximately 0.030 in. (0.8 mm).

(h) Use a 0.048-in. Bristol wrench to tighten the setscrews.

(i) Visually check the spacing between the knob and the bezel to make sure that the knob has not slipped during installation.

(j) Slide the DIM knob onto the shaft.

(k) Use a 0.048-in. Bristol wrench to tighten the setscrews.

(l) Make sure that the DIM knob has not slipped during installation and that it is not rubbing against the inside of the MODE knob.

10. Procedure for the MS-560 Mode Selector

A. Removal and Installation Procedures

(1) Remove the mode selector as follows:

(a) Remove and save the four machine screws that attach the mode selector to the instrument panel.

(b) Slide the unit out of the aircraft mounting location and disconnect the cable connector.

(2) Install the mode selector as follows:

(a) Mate the cable connector with the unit connector.

(b) Slide the unit into the instrument panel.

(c) Secure the unit with the previously saved hardware.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the button lamps as follows:

NOTE: Access to these lamps does not require removal of the bezel.

CAUTION: THE BUTTON COVERS ARE HELD CAPTIVE TO THE SWITCHES WITH SPRING WIRE. BE CAREFUL NOT TO PULL THE COVER OUT TOO FAR, AS DAMAGE CAN OCCUR TO THE SWITCH.

(a) Use an IC puller to remove the button cover and pull it straight out. If no puller is available, an orange stick can be used. Do not use anything metallic, such as a thin screwdriver, because of the danger of damage to the switches and/or the bezel.

NOTE: Each button has two lamps. The lamp at the left is clear, and the lamp at the right is blue-white.

(b) Remove the lamp by pulling it straight out.

(c) Install the new lamp.

(d) Align the button cover on the switch.

(e) Push the button cover into the switch until it clicks into place.

11. Procedure for the PC-400 Autopilot Controller

A. Removal and Installation Procedures

(1) Remove the autopilot controller as follows:

(a) Disengage the Dzus fasteners on the unit.

(b) Slide the unit out of the aircraft mounting location and disconnect the cable connector.

(2) Install the autopilot controller as follows:

(a) Mate the cable connector with the unit connector and slide the unit into the aircraft mounting location.

(b) Engage the Dzus fasteners on the unit.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the TURN knob as follows:

(a) Use a 5/64-in. Allen wrench to loosen both setscrews in the knob.

(b) Slide the knob off the shaft.

(c) Examine the new knob to make sure that the setscrews are out far enough to allow the knob to slide onto the shaft. Apply retaining compound to the setscrews.

(d) Slide the knob onto the shaft.

(e) Make sure that the space between the knob and the front panel is approximately 0.030 in. (0.8 mm).

(f) Tighten the setscrews.

(g) Visually check the spacing between the knob and the front panel to make sure that the knob has not slipped during installation.

(2) Replace the button lamps as follows:

NOTE: Access to these lamps does not require removal of knobs or bezel.

CAUTION: THE BUTTON COVERS ARE HELD CAPTIVE TO THE SWITCHES WITH SPRING WIRE. BE CAREFUL NOT TO PULL THE COVER OUT TOO FAR, AS DAMAGE CAN OCCUR TO THE SWITCH.

(a) Use an IC puller to remove the button cover and pull it straight out. If no puller is available, an orange stick can be used. Do not use anything metallic, such as a thin screwdriver, because of the danger of damage to the switches and/or the bezel.

NOTE: Each button cover contains one clear lamp at the right and a dummy lamp at the left.

(b) Remove the lamp by pulling it straight out.

(c) Install the new lamp.

(d) Align the button cover on the switch.

(e) Push the button cover into the switch until it clicks into place.

12. Procedure for the RI-552 and RI-553 Remote Instrument Controllers

A. Removal and Installation Procedures

(1) Remove the remote instrument controller as follows:

(a) Disengage the Dzus fasteners on the unit.

(b) Slide the unit out of the aircraft mounting location and disconnect the cable connector.

(2) Install the remote instrument controller as follows:

(a) Mate the cable connector with the unit connector and slide the unit into the aircraft mounting location.

(b) Engage the Dzus fasteners on the unit.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the HEADING or COURSE knobs as follows:

(a) Use a 0.048-in. Bristol wrench to loosen both setscrews on the knob(s).

(b) Slide the knob(s) off the shaft(s).

NOTE: The left and right knobs are COURSE knobs, and the center knob is a HEADING knob.

(c) Examine the new knobs to make sure that the setscrews are out far enough to allow the knob to slide onto the shaft. Apply retaining compound to the setscrews.

(d) Slide the knob onto the shaft.

(e) Make sure that the space between the knob and the bezel is approximately 0.030 in. (0.8 mm).

(f) Use a 0.048-in. Bristol wrench to tighten the setscrews.

(g) Visually check the spacing between the knob(s) and the bezel to make sure that the knob(s) have not slipped during installation.

13. Procedure for the SM-200 Servo Drive and SB-201 Drum and Bracket Assembly

A. Removal and Installation Procedures

(1) Remove the servo drive as follows:

(a) Disconnect the cable connector from the servo drive.

(b) Cut the safety wire. Remove and set aside the four screws and lock washers that attach the servo drive to the drum and bracket assembly.

(c) Slide the servo drive out of the drum and bracket assembly.

(2) Install the servo drive as follows:

(a) Slide the servo drive into the rear of the drum and bracket assembly.

(b) Secure with four screws, Honeywell Part No. 4011086, and lock washers previously set aside.

(c) Safety wire all four screws with Low Mu Monel wire, 0.020-in. diameter.

(d) Mate the servo drive connector with the cable connector.

(3) Remove the drum and bracket assembly as follows:

(a) Remove the servo drive in accordance with paragraph 13.A.(1).

(b) Release the bridle cable tension.

(c) Cut the safety wire on the four screws that secure the retaining plate. Remove and set aside the screws and the retaining plate.

(d) Remove and set aside the four cable keepers, Honeywell Part No. 2518330.

(e) Cut the safety wire. Remove and set aside two screws that attach the swaged cable terminals to the drum.

(f) Unwrap the bridle cables from the drum.

(g) Remove and set aside four nuts, bolts, and washers that attach the drum and the bracket assembly to the airframe.

(h) Lift the drum and bracket assembly away from the airframe.

(4) Install the drum and bracket assembly as follows:

(a) Mount the drum and bracket assembly rigidly to the airframe with four bolts, lockwashers, and nuts previously set aside.

INSTALLATION CRITICAL

TO MAKE SURE THAT THE CABLE TERMINAL IS CAPTURED, USE ONLY 0.138-32-NC-2A STAINLESS STEEL DRILLED SCREWS, HONEYWELL PART NO. 2554911-1. STANDARD FILLISTER-HEAD SCREWS MAY NOT PROPERLY RETAIN THE CABLE TERMINAL.

(b) Wrap the bridle cables around the servo bracket drum. Secure the swaged cable terminals to the servo bracket drum with the screws removed in paragraph 13.A.(3)(e), or if a new servo, use the screws supplied with the new servo. Safety wire the screws through adjacent holes in the drum with Low Mu Monel wire, 0.020-in. diameter and 4 inches long.

(c) Adjust the control system and the bridle cables to the proper tension as instructed in the aircraft maintenance manual.

INSTALLATION CRITICAL

TO MAKE SURE THAT THE CABLE CANNOT JAM BETWEEN THE DRUM AND KEEPERS, THE DISTANCE BETWEEN THE KEEPERS AND DRUM MUST BE MEASURED AFTER THE KEEPERS AND RETAINING PLATE ARE INSTALLED. THE DISTANCE BETWEEN THE DRUM AND KEEPERS MUST NOT EXCEED 0.040 INCH AND MUST NOT BE LESS THAN 0.005 INCH. THE 3/32-INCH CABLE DIAMETER MUST BE VERIFIED. THESE ARE CRITICAL INSTALLATION REQUIREMENTS.

(d) Install two of the four cable keepers removed in paragraph 13.A.(3)(d), on the servo bracket at the points of cable tangency to the drum. The other two keepers must be located at 90 degrees from the first two.

(e) Install the retaining plate, Honeywell Part No. 2518332, on the slotted end of the cable keepers using the four 5/16-in. long, No. 8-32, drilled fillister-head screws removed in paragraph 13.A.(3)(c). Safety wire these four screws with Low Mu Monel wire, 0.032-in. diameter and 4 inches long.

(f) Install the servo drive in accordance with paragraph 13.A.(2).

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Not applicable.

14. Procedure for the WC-880 Weather Radar Controller

A. Removal and Installation Procedures

(1) Remove the weather radar controller as follows:

(a) Disengage the Dzus fasteners on the unit.

(b) Slide the unit out of the aircraft mounting location and disconnect the cable connector.

(2) Install the weather radar controller as follows:

(a) Mate the cable connector with the unit connector and slide the unit into the aircraft mounting location.

(b) Engage the Dzus fasteners on the unit.

B. Adjustment Procedures

(1) Not applicable.

C. Repair Procedures

(1) Replace the control knobs as follows:

(a) Use a 0.048-in. outside diameter, 6 flute Bristol wrench to loosen the setscrews.

(b) Slide the knob off the shaft.

(c) Examine the new knobs to make sure that the setscrews are out far enough to allow the knob to slide onto the shaft. Apply retaining compound to setscrews.

(d) Slide the knob onto the shaft.

(e) Make sure that the space between the knob and the front panel is approximately 0.030 in. (0.8 mm).

(f) Tighten the setscrews.

(g) Visually check the spacing between the knob and the front panel to make sure that the knob has not slipped during installation.

15. Procedure for the WU-880 Antenna and Receiver Transmitter Unit

A. Removal and Installation Procedures

(1) Remove the antenna and receiver transmitter unit as follows:

(a) Disconnect the cable connector from the unit.

(b) Remove and set aside the hardware used to attach the unit to the airframe.

(2) Install the antenna and receiver transmitter unit as follows:

(a) Attach the unit to the airframe with the hardware previously set aside.

(b) Mate the aircraft cable connector with the unit connector.

B. Adjustment Procedures

(1) Adjust the elevation feedback as follows:

NOTE: This procedure must be done by two persons, one in the cockpit and one at the unit.

WARNING: WHEN THE RADAR SYSTEM IS ON, DO NOT GET CLOSER THAN THE MAXIMUM PERMISSIBLE EXPOSURE LEVEL (MPEL) RADIUS OF THE ANTENNA. MAKE SURE THAT YOU KNOW THE MPEL RADIUS FOR YOUR SYSTEM, AND OBEY APPROVED SAFETY STANDARDS TO PREVENT INJURY TO PERSONNEL.

WARNING: DO NOT OPERATE THE RADAR SYSTEM LESS THAN 50 FEET FROM OTHER AIRCRAFT OR OBJECTS. THIS WILL HELP PREVENT INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: DO NOT OPERATE THE RADAR SYSTEM LESS THAN 100 FEET FROM REFUELING OPERATIONS. THIS WILL HELP PREVENT INJURIES TO PERSONNEL AND DAMAGE TO THE EQUIPMENT.

WARNING: DO NOT LOOK DIRECTLY INTO THE ANTENNA FOR LONG PERIODS WHILE IT IS IN OPERATION. THE HEAT CAUSED BY THE RADAR ENERGY IS DANGEROUS FOR YOUR EYES.

(a) Before you apply power to the radar, set the SCAN and XMTR toggle switches on the unit housing to OFF (toward antenna).

(b) Level the pitch and roll axes of the aircraft relative to the earth's surface.

(c) Verify that the mounting surface of the unit is aligned to the pitch and roll reference axes of the aircraft within ± 0.25 degree.

(d) Apply aircraft power as necessary.

(e) On the WC-880 radar controller, make the following selections:

- RADAR = SBY
- TILT = 0°
- GAIN = Push knob in for preset gain.

(f) During the 45-second wait period, the unit sets the azimuth and elevation to 0.0 degrees independent of any external inputs. The following check/adjustment should be done only during this wait period. Make sure that the flat-plate antenna is at 0.0 ± 0.5 degree with respect to the unit mounting surface. If not, adjust the elevation feedback potentiometer R1 so that the antenna is at 0.0 ± 0.25 degree with respect to the unit mounting surface.

NOTE: The elevation feedback potentiometer, R1, is located on the right side (viewed looking back at the aircraft) of the yoke/gimbal assembly on the RTA (near the magnetron). The potentiometer will have a black body (early units had a blue bodied potentiometer). To adjust the potentiometer, loosen the screws on the two shoulder washers that hold the potentiometer body tight against the mounting plate. Adjust the potentiometer and then retighten the screws, making sure that the tilt remains at 0.0 ± 0.25 degree.

(2) Adjust the roll offset compensation as follows:

NOTE: This procedure is done while airborne. The roll offset is preset at the factory so the procedure is necessary only if a roll offset error is detected.

(a) At an altitude of 10,000 ft (3,048 meters) or greater above the ground, establish a wings-level cruise attitude.

(b) On the WC-880 radar controller, select the WX mode, 100 NM range, variable GAIN, and RCT OFF. Observe that the VAR is displayed in the WX mode box on the MFD.

(c) Adjust the antenna tilt down until a fairly solid band of ground clutter is visible.

(d) Select RCT on-off-on-off within 3 seconds by setting RADAR knob between RCT and WX. VAR should not be displayed. This puts the radar in the roll compensation mode.

(e) Push the RCT button once more or set the RADAR knob between RCT and WX again and make sure that VAR is not displayed. If it is, repeat this step.

(f) Adjust the GAIN control on the WC-880 radar controller until the ground clutter display is symmetrical.

(g) Do not touch the manual GAIN control once the display is adjusted properly.

(h) Push the RCT button once and then three more times within 4 seconds or select RCT on-off-on-off within 3 seconds by setting the RADAR knob between RCT and WX. This causes the WU-880 to exit the roll compensation mode. When VAR is displayed again, the roll compensation mode has been exited.

(i) Set the variable or preset GAIN as desired.

(j) This compensation data is now stored in nonvolatile memory in the WU-880 and will not be erased when power is removed from the system.

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SECTION 5
SHIPPING/HANDLING AND STORAGE

1. Overview

A. General

(1) Refer to manual, Pub. No. A09-1100-001, for detailed procedures for preparing all system components for storage or shipment.

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SECTION 6
HONEYWELL SUPPORT

1. Worldwide Exchange/Rental Program for Corporate Operators

A. General

(1) Honeywell's spares exchange (SPEX) program is a worldwide exchange/rental service for corporate operators. It provides an extensive service for LRU end-item products, complementing our worldwide support center network. An inventory of more than 8,000 spare components ensures that your Honeywell-equipped aircraft will be returned to service promptly and economically. This service is available both during and after warranty.

B. Exchange

(1) Upon receipt of an exchange request, Honeywell ships a fully certified unit. The SPEX-provided unit becomes the property of the customer. The customer returns the faulty unit in exchange, to the designated Honeywell Product Support Center, where it becomes the property of Honeywell. All exchange units are updated with the latest performance reliability MODs on an attrition basis while in the repair cycle.

C. Rental

(1) Upon receipt of a rental request, Honeywell ships a fully certified unit. The customer then ships the faulty unit to an authorized support center for service. When the faulty unit has been serviced and installed, the rental unit is returned to the designated Honeywell Product Support Center.

D. Warranty

(1) The SPEX 12-month warranty commences upon the purchase of an exchange unit by the customer at catalog list price.

(2) Any exchange or repair action taken during the New Product or SPEX warranty period does not extend or otherwise affect the warranty expiration date.

(3) Services provided for a failed unit under New Product warranty include:

- Free repair and/or free rental (during repair of unit), or
- Free exchange.

(4) Services provided for a failed unit under SPEX warranty include:

- Free repair and billable rental, or
- Free exchange.

(5) Services provided for a failed unit under repair warranty include free rental if the customer paid for a billable rental during the initial repair of the failed unit.

E. Warranty Statement

(1) Honeywell warrants that any article provided under the SPEX program will, at the time of delivery, conform to all applicable specifications and drawings and be free of defects in material and workmanship. Honeywell's obligation under this warranty, however, shall be limited to repair of or, at Honeywell's option, replacement of any article returned to Honeywell within the stipulated twelve-month warranty period.

(2) For further information regarding exchange or rental units, contact any of the Honeywell facilities listed at the end of this section.

F. Routine Repair Piece Part Orders

(1) Customers desiring to place routine repair piece part orders, determine order status, upgrade an existing order, or request price and delivery for piece parts should contact the Customer Service Representative in Phoenix, Arizona at:

- Telephone number . . . . (602)436-0272
- Fax number . . . . (602)877-7272.

G. Exchange and Rental Ordering

(1) Telephone

(a) Place an order by calling one of the following numbers:

- Inside U.S.A., Dallas, TX 1-800-872-7739
- Outside U.S.A., Dallas, TX (214)402-4300
- United Kingdom, Basingstoke 44-1256-51111
- France, Toulouse 33-6171-9662
- Germany, Gauting 49-89-89317-226
  (After normal working hours: 49-89-850-3695)
- Singapore 65-542-1313
- Singapore 65-542-1313
- Australia, Tullamarine 61-3-330-1411
- Brazil, Sao Paulo 55-11-535-0513.

H. Ordering Information

(1) When placing an order, Honeywell needs the following information:

- Part number with dash number of faulty unit
- Serial number of faulty unit
- Aircraft type, serial number, and registration number
- Aircraft owner
- Reported complaint with faulty unit
- Service requested (exchange or rental)
- Shipping address
- If faulty unit is in warranty
- Type of warranty (new or SPEX)
- Date warranty started
- If faulty unit is NOT in warranty, provide billing address
- If faulty unit is covered under a maintenance contract
- Type of contract
- Contract ID number
- Purchase order number.

NOTE: Units will ship same day or within 24 hours.

NOTE: Shipments within the U.S. will be shipped next day air, P.M. delivery, unless otherwise specified.

I. Return Shipping Procedures

(1) Shipping Container

(a) All components returned to Honeywell must be packed in the same (or Honeywell approved equivalent) container in which the component was received. Components which are received in IMPROPER containers may be subject to DAMAGE charges.

NOTE: Please ship the return unit to the support center indicated on the document provided. Include completed multipage exchange and rental tag attached to unit, and any additional information, if required.

(2) Shipping Instructions

(a) North America Customers

1 Ship via Federal Express Standard Air, two-day delivery. If not served by Federal Express, ship via airline direct airfreight, not via a freight forwarder. Shipment via a surface carrier may result in assessment of LATE RETURN CHARGES.

(b) Europe and Africa Customers

1 Return unit to the Honeywell Customer Support Center that issued the replacement or with prior arrangement to any one of the following addresses:

- Honeywell Aerospace
  1, Rue Marcel Doret
  31700 Blagnac
  c/o SCAC Air Service
  6, Allee Henri Potez
  31702 Blagnac
- Honeywell Avionics Systems Ltd.
  c/o Burlington Air Express
  Unitiair Centre, Great South West Road
  Feltam, Middlesex TW 14 8NT
  England, U.K.

(c) Other International Customers

1 Return unit to the Honeywell Customer Support Center that issued the replacement. Shipments returning to the United States should be via Burlington Air Express. If you are not served by Burlington Air Express, ship by Emery Airfreight or by direct airline airfreight. Consign shipments to the following address:

Honeywell Inc.
c/o F. H. Kaysing Co.
U.S. Customs House Broker
Mid Continent Airport
Wichita, Kansas 67209
U.S.A.

NOTE: Do not insure or declare an insurance value on the bill of lading. Honeywell is self-insured.

2. Test Equipment

A. Special Test Equipment

(1) Specialized test equipment is not required for normal flight line maintenance of Honeywell avionics. Certain standard, commercially available avionics aids such as ramp (signal) checkers, oscilloscopes, meters, etc., may be useful for more detailed troubleshooting. A breakout box can also be helpful for certain equipment, and availability of this item can be discussed with a Honeywell Customer Engineer.

3. Customer Engineering

A. General

(1) A key element in Honeywell's corporate operations support is our worldwide customer engineering organization. The members of this group are strategically located around the world. These individuals have earned an excellent reputation within the avionics industry as the result of their high level of education, experience, dedication, and responsiveness.

(2) Customer engineering is ready to provide corporate operators with onsite technical assistance, provisioning consultation, training, and regulatory agency coordination. In addition, customer engineers will provide engineering interface assistance for other interrelated equipment on the aircraft and will support your maintenance engineers and technicians. Continuing assistance is provided through telephone consultation or at your facility, as requirements dictate.

(3) For the name, address, and telephone number of the Honeywell customer engineer nearest to your facility, please call (877)436-2005 or your nearest Honeywell support center.

4. Training

A. General

(1) Honeywell's dedicated customer training staff is available to assist corporate operators in acquiring the technical skills and knowledge needed to operate and maintain Honeywell products.

(2) Customer training conducts formal courses on corporate aircraft systems/products at Honeywell's Customer Training Center in Phoenix, Arizona, and at selected locations worldwide. Courses are scheduled annually based on customer interest and new aircraft delivery projections. A regularly updated Honeywell Customer Training Schedule brochure gives full details of all training courses offered.

(3) Honeywell offers the following level of training courses:

- Operational (pilot) training
- Flight line maintenance training
- Component level maintenance training.

(4) For full details and information on Honeywell training courses, or for a copy of the Honeywell Customer Training Schedule, contact the Customer Training Department in Phoenix, Arizona at:

- Telephone number: (602)436-6742
- Fax number: (602)436-1037.

5. Honeywell Product Support Centers

A. General

(1) For a complete listing of all Honeywell Support Centers, go to the Honeywell Aerospace Electronic Systems - Customer Services Web site at http://www.avionicservices.com/home.jsp.

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SECTION 7
SYSTEM TEST AND FAULT ISOLATION

1. Test and Fault Isolation

A. General

(1) Refer to the Cessna Citation XLS AMM and FIM for test and fault isolation procedures.

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